THE HUMAN SIDE OF TREES

ROYAL DIXON AND FRANKLYN E. FITCH

THE HUMAN SIDE OF TREES

LIGNUM VITÆ. *Guaiacum sanctum.*

With its dainty blue flowers in their setting of green leaves, this is a veritable sprite of the woods.

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THE HUMAN SIDE OF TREES

WONDERS OF THE TREE WORLD

BY

ROYAL DIXON

AND

FRANKLYN EVERETT FITCH

WITH FOUR ILLUSTRATIONS IN COLORS AND THIRTY-TWO IN BLACK-AND-WHITE

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TO

COLONEL THEODORE ROOSEVELT

AMERICA'S FOREMOST NATURALIST

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I care not how men trace their ancestry,
To ape or Adam: let them please their whim;
But I in June am midway to believe
A tree among my fair progenitors.
Such sympathy is mine with all the race,
Such mutual recognition vaguely sweet
There is between us,—surely there are times
When they consent to own me of their kin,
And condescend to me, and call me cousin.

—LOWELL

INTRODUCTION

MAN is the highest form of animal life and the trees are the highest form of vegetable life. They have much in common.

We humans are inclined to assume too great a superiority over our fellow creatures of a great universe. The doctrine that the earth was created for our special benefit still obtains a wide credence. We lose sight of the fact that, after all, plants, animals and the human biped are all made of the same stuff, by the same God; governed by the same chemical and physical laws and subject to the same final bodily dissolution.

In *The Human Side of Plants* it has been shown that plants and trees possess certain mental and moral characteristics and the attributes of reason, memory, hope, language, love, and all forms of righteous ambition. These in man we claim to belong to an immortal spirit, rather than to an earthly body. Why not make the same concession to the trees?

Few thinking minds can study these marvellous beings and fail to be convinced that they are living

exponents of a beneficent Creator. They may be as needful in a world of spirit as they are on this earthly plane of existence. If man is to carry over his present life into a future world why should not plant creatures also share the same chance to reach out to higher and better development? All life is one, partly a breathing, earthly frame and partly a spiritual essence. "As all existence is a unit," says Thomas Gentry, "it can hardly be conceived that an all-wise God, who is infinite in love, mercy, and justice, would look to the preservation in a future state of but a very small part of the life which He has been instrumental in placing upon this earth. It would be more consistent with His attributes, and with the scheme of development of life upon our planet, whereby life has been progressive, the fittest only being allowed to survive, to have provided in the grand plan of redemption, not merely the salvation of the highest of earth-life, but of all life, the purest and the best, that would represent in the heaven-life, in spiritualised form, the highest living exponents of divine ideas. No other belief accords so well with the teachings of science and philosophy. Only in its acceptance, for it makes all life related to the divine life, can there be any hope of escape from materialism, that curse of the age."

In the following chapters it at least is shown that these noble forest giants which the average man looks upon as mere food for the pulp mills, are living, growing, thinking creatures, with definite habits of life, efficient business methods, and characters often more to be admired than the men who chop them down.

From earliest times men have recognised psychic personalities among the trees. For long periods they worshipped them as incarnations or temporary abiding places of supernatural spirits. The selection of certain trees as sacred has happened many times and through all ages. In every land the instances of plant deification are numerous; even in the present day, superstition attributes innumerable mysterious powers to trees. In the annals of every great religion, from Confucianism to Christianity, trees have stood forth prominently; in every sacred volume from the Zend Avesta to the Old and New Testaments their acts are recorded.

Great men of all ages have felt a peculiar kinship for their forest friends. Under the inspiring shade of sympathetic branches some of the world's greatest thoughts have come to birth. At all times the trees have exercised a profound influence upon the universe.

The functions of the trees are many. They give

shade. They beautify the landscape. They purify the air. They regulate drainage, preventing both destroying droughts and devastating floods. By exhaling moisture, they help to keep the atmospheric humidity right. They break the force of cyclonic winds. Their protection keeps the earth soft and fresh and capable of growing things. They shelter innumerable plants and animals which otherwise would become extinct. Their absence or presence literally determines the shape and character of continents as well as the type of men and animals which live on them.

We do not claim for plants and trees the slightest equality with man; but we do claim that they are beings which in a minor degree have all human pleasures and understandings, and that in the future life they will very likely be compensated for their struggles and difficulties here in this world. The ruthless destruction of them is due to man's exalted opinion of himself, of considering them as lifeless things without susceptibilities, without reason, and without hope for a future. If man has a soul, so have trees.

Economically the trees are indispensable. Take all the tree products out of our daily life and we should be a long time readjusting ourselves. The cocoanut palm is an example of a single tree which

can be made to supply all the needs of a not too-luxurious member of society. In certain islands of the seas this prolific plant furnishes the natives with the wood from which they build their houses, their boats and their utensils. When the leaves are young, they are eaten. When they are old, they are woven and braided into hats, baskets, cloth, fans, bedding, paper, and thatch. The ribs of the mature leaves are converted into arrows, spears, brooms, torches, and paddles. Out of the flowers come wine, vinegar, and sugar. The fruit makes a delicious food, and its husk yields oil, cord, and matting. Even the roots of this useful creature are sometimes used for food.

These things are not cited to further the idea that the trees were created to be the servants of man. They have their own lives to live and their own problems to solve. But under the existing laws of life, every creature lives at the expense or rather by the help and co-operation of many others. Man, as the highest type of vegetable or animal life yet evolved, is able to enlist the services of vast numbers of his fellow creatures. Right generous and royal is their co-operation, and often beastly and rapacious is his squandering of their lives and bodies.

Botanically, trees are perennial plants having

woody stems and branches. They are distinguished from bushes and shrubs by ordinarily possessing only one trunk. Yet despite their size and marked individuality of form, trees have the roots, the stem, the leaves, the fruit, and the seeds characteristic of all plants.

It really is most remarkable that, despite many adverse conditions, the trees enjoy the distinction of becoming, as a class, the very oldest of living earthly things. They cannot evade or run away from danger. Patiently they must endure drought, flood, earthquake, fire, storm, and insects. Yet many of them rise superior to all forces working for their destruction and reach ages which cause even man to marvel.

The aim of this book is to present the trees as living, lovable personalities—working and playing in a world quite as real and vital as our own; and possessing many habits and attributes which we often imagine are exclusively human. They are far more sensitive to climatic conditions than man, and in some of them is discernible a strangeness of expression that is difficult to understand. Only a rash and presumptuous person would dare say that trees are not endowed with a consciousness, no matter how infinitesimally small it may be.

Make friends with the trees and they will make

friends with you. Places of friendly contact with them are not always easy to find, but they are there, and it is usually the mental attitude of the seeker which obscures them. When the State of Nebraska set aside the first Arbor Day in 1872, it started an enthusiastic movement which has since swept over the entire country and surged over the seas to foreign soil. The old reverence for the trees still exists, even if it sometimes has been almost entirely obscured by long dwelling amid brick and mortar.

Genuine acquaintance with the trees reacts upon the nature-lover's soul with startling effect. What man is so base and sordid that he can contemplate the beauties of an autumn wood without feeling some measure of uplift and ennoblement? What blind eye is so filmed by materialism that it can watch a tiny seed develop into tons of solid timber and then declare there is no God?

THE HUMAN SIDE OF TREES

THE HUMAN SIDE OF TREES

I

TREES THAT BUILD CITIES

A brotherhood of venerable trees.
—WORDSWORTH.

MEN assemble themselves into cities for mutual help and protection. So do the trees. "Union makes strength" is a motto they have permanently adopted. There are hermits among the leaf-clad pioneers, but the great majority, like human beings, prefer to dwell together in vast allied groups.

In the fierceness of its life-struggle, the tree city resembles a mediæval town more than it does the orderly human centre of the present day. There is a vigour and primitive relentlessness which indicates an untrammelled belief in "the survival of the fittest."

Every tree city comes into being in a most romantic way. It grows but it does not "just grow."

At some far distant epoch, sturdy exploring trees established the settlement, struggled against adverse conditions, baffled with unruly friends, failed perhaps, were almost wiped out, rallied again, and finally, little by little, like a group of well-organised business men, pushed the colony to self-sustaining proportions.

Perhaps the original site was on the edge of a plain or prairie, grass-covered and dreary. Some far-roaming tree-seeds, borne high by a generous wind, spied this desirable place and were happy.

"A new and marvellous country!" they cry. "Here we will have peace and little competition, and we can build a pleasant home. Let us down, good wind; we will fly no farther."

So the wind puts on his brakes, and all the little tree-seeds tumble to the ground, alighting in various good positions, one seeking this spot, another seeking that, and every one looking for the very place he likes best. Some places are a little hard, but when the baby seeds have sprouted and pushed their tiny roots into the soil, they find that the earth tastes good and is moist and rich. How delightful to drink up water from the hospitable ground! And food! Everything seems so easy and wonderful; the earth, the sunshine, and the air supply all. Gaily and quickly tiny shoots begin to grow, and

reach up toward the sunshine and the great sky.

Alas, for the young and inexperienced! A greedy bird pulls up and eats some of the choicest seedlings. A careless animal tramples half their number to death. That very autumn there comes a drought. Rain does not fall for months. Even the strongest roots shrink up with thirst; they grow seer and yellow with premature age. Then comes not the deluge, but the fire of destruction. A great conflagration roars across the horizon, advances with incredible rapidity and licks up the whole colony with one cruel tongue of flame.

Everything is over now—No, not quite. Three or four of the hardiest varieties, especially those that had sent roots deep into the soil, still have a little life left. All winter long they lie dormant, but with spring's quickening touch they raise feeble heads and push their way up into the sunlight. They are ready to start all over again!

So is a tree colony founded in toil and tribulation, and year after year must its members struggle both with outside agencies and among themselves. The more one studies a tree city, the closer does its resemblance to human cities appear. The more one studies a single tree, the more it seems like some lone human soul struggling for life amid millions of its fellows.

Humans speak of fleeing city streets and getting out into the woods. If they but realised it, they are merely journeying from one city to a better one —from man's poor imitation to nature's splendid consummation. We agree with Emerson that "in the woods is perpetual youth. Within these plantations of God a decorum and sanctity reign, a perennial festival is dressed, and the guest sees not how he should tire of them in a thousand years."

Tree cities! This idea is something more than a pretty analogy. Let us mount above some great forest by aeroplane and observe its great and salient features *en masse*. The streets, alas, are for the most part hidden, but we know that they are there—great, cathedral passageways, high-flung and canopied, protected alike from browning sun and threatening shower.

As we soar high and free on the wings of man's genius, we recognise various quarters of this city of leafy billows—sections of light green; regions close-knit and impenetrable; regions freer and more open—all telling of the wide-spreading mansions and the close-packed tenements of a cosmopolitan origin. Here and there are rocky open places, as if the trees too required their breathing spaces in which to stretch their knotted and restricted limbs. Sometimes a lonely sycamore or plane tree stands

"IN THE WOODS IS PERPETUAL YOUTH"

A TREE-CITY IN IDAHO, WHERE PINE, TAMARACK, AND CEDAR DWELL TOGETHER IN PERFECT ACCORD

in the middle of such a clearing, or near a small stream, with self-contained grandeur, and one is reminded of the words of Bryant:

> "Clear are the depths where its eddies play,
> And the dimples deepen and hurl away;
> And the plane tree's speckled arms o'ershoot
> The swifter current that mines its root."

It flings its arms far and wide in untrammelled vigour and attains a size and majesty impossible within the solid phalanxes of its fellows. Another tree which likes so to splurge is the beech. It is by nature extremely masterful and monopolistic. In the confines of the woods, its trunk often rises fifty or sixty feet without branches, but when given elbow-room it broadens out laterally so far that the ends of the side-shoots almost touch the ground.

Our bird's-eye view complete, let us go down into the city and with our own feet tread its moss-paved, bark-walled streets.

Our eyes see a very beautiful forest but they have not been trained to discern the subtler facts. We shall call upon a naturalist to act as sightseeing megaphone man. He is well acquainted with all the inhabitants and speaks their language. He will very likely first direct attention to the endless man-like struggle for existence which permeates woodland life. He will point out that as soon as

a tree is born it must begin a never-ending effort to gain for itself a full quota of light and air. It stands shoulder to shoulder with other saplings, all growing up in the shadow of larger trees. The one that grows the fastest is assured of a long life and abundant foliage. He who lags behind becomes first a little smaller than his fellows, then of noticeably retarded and restricted crown, then suppressed or hopelessly out of the running, and finally an invalid who dwindles to a speedy death. The mortality among the baby trees is very great, and becomes less as maturity is reached. Occasionally we meet a life-long sick man who, with bent or broken trunk, is dragging out a weary existence.

Metropolitan life is inclined to be enervating. Foresters tell us that growth is so retarded in a tree city that an Adirondack spruce which takes one hundred and eighty years to attain a diameter of twelve feet could secure this dimension in one hundred years under unhampered conditions.

There are a few inhabitants of the forest who deliberately choose what form their physical body shall take. This body must suit their environment. If they see that restricted conditions of light and air surround their early life, they become vines; but when given more room they develop into luxurious trees. The wild fig of South America is a

typical example of this self-willed being, and our own wistaria is subject to the same tendency.

Besides competition among themselves, the trees have to endure the very formidable depredations of certain underworld elements. There are very vicious criminals in every tree city against which only a weak general police protection is opposed. Grafters, gangsters, thugs, highwaymen, and murderers wage incessant war and do incalculable harm.

Grafters are as common throughout the vegetable world as they are in the human world, and trees are often their victims. Some of them, like the beautiful orchid or our familiar morning-glory, do not take more than the not unkindly support of some tree's strong trunk in their weak-kneed ascent toward light and air. Others, like the mistletoe, go a step further and after abandoning all connection with the ground, send food-seeking roots into the vitals of the oak, the poplar, or the elm. But this is mere petty thievery compared to the incredulous rapacity of such plants as the Murderer Liana of the tropics, which actually chokes to death the tree on whose trunk it climbs up to health and strength.

Parasitic insects reap a heavy toll in a tree city. Several varieties of these pests are always at work among the tree inhabitants. Naturalists believe

that a sudden invasion of exceptionally large hordes of some particular species has often depopulated entire tree cities at different times in the world's history. In recent years the people of South Dakota and Wyoming have seen vast areas ruined by the depredations of bark-beetles; and only the combined efforts of the United States Department of Agriculture and the authorities of several of the New England States prevented very serious results as an outcome of the invasion of the gipsy moth and the browntail moth. Insects can be held accountable for most of the forest fires. A widespread raid fills many square miles with the bodies of their victims, and there is admirable tinder for the lightning to set ablaze.

In combating vegetable and insect enemies, the trees often make defensive alliances with other more friendly neighbours. They shelter birds, moths, ants, squirrels, and other creatures, and even feed them with their fruit, in order to be provided with aerial squadrons and standing armies to fight for them. It is to the dependents' interest to protect their benefactor against all comers. Right loyal is their service.

A weak or invalid tree we have many times seen; but we do not ordinarily think of trees as being subject to disease in the way human beings are.

Yet, in reality, such is true. In the streets of a tree city there always are deadly germs flying about. Scientists call them spores and their resultant diseases blights or fungous growths, but the fact is that they often seriously cripple or kill their victims. A tree may have had a limb lopped off by wind, ice or fire, or perhaps an obscure insect has merely bored a tiny hole through its bark. At any rate, the deadly germ gains entrance and the unfortunate must battle with an enemy which is attacking its vitals.

So far we have drawn a rather dark and pessimistic picture of the tree-citizen's life. Needless to say, it has its sunny side. There is no human being so sunk in misery and degradation as to have nothing to be thankful for; there is no poor shell of a tree so encompassed by adversity that it cannot give praise for the rain, the sunlight and the ministrations of friendly plants and animals. There is much selfishness and hard-dealing, we might say misunderstanding, in a tree city, but there is also much kindness and charitableness. The strong often protect the weak. Ferns and mosses owe their luxuriance to the shade provided by their tree neighbours. Myriads of the smaller plants, like the delicate cypress vine, not only must receive protection from the hot sun and strong wind at the feet of

stronger friends, but must lean and climb upon friendly neighbours in order to get a chance in life. Plants have a wonderful regard for friendship, and are by nature extremely sociable. They invariably group themselves according to their likes and dislikes.

Certain types of trees show a wonderful maternal interest in their children. We ordinarily think of plants of all kinds as mechanically producing seeds and then placing their entire development in the hands of Mother Nature. In some cases this is so, as it is in human families; but there are just as many plant-mothers who show the utmost favour and solicitude for their children.

Practically all trees see that their seed-babies are carefully covered up with a warm blanket of leaves and bark which also will furnish nourishment when the infants begin to send their tiny stalks up into the air. The screw-pine frequently drops its seeds on the fallen trunk of some dead neighbour. There they sit astride of perhaps their grandmother's back and, sending forth roots, grow to young maturity on the very substance of an earlier member of the family. A more striking example of a mother's self-sacrifice is shown by the sweet-gum, sometimes called gum-amber, which actually plants seeds within itself. The tree first grows hollow within,

and then the seeds find their way into the hollow. When the tree is ready to die, the young take up the life-thread, and pushing their way through crevices in the bark, burst the maternal trunk asunder. Here is a tree which by perfect analogy, like the mammals among animals, shelters its young within its own body.

We have seen that a tree city has its bad people and its good people—citizens who seem to be ruled by the worst of the human passions and inhabitants who have those kindlier—if you will, Christian—attributes that we all admire. Look a little at a tree city's mechanical organisation. Gas, water, and electricity—how are they distributed?

First, consider water, for it is the most vital. There is no need to lay mains, for nature has provided underground rocky conduits which end by diffusing their contents through the sub-soils. Thirsty roots drink up the water like miniature fire-hydrants. On a warm day a large tree will absorb many tons of moisture. The water is taken up by the roots which have bored deep down into the moist soil; but how does it get upstairs? This seems like a simple question at first, but it is a pretty little problem if studied seriously. Scientists studied it many years before arriving at a satisfactory explanation. Thirty feet of the rise of water in a

tree can be explained by ordinary atmospheric pressure, but many trees are four times that height.

The "hydrostatic paradox" gives the answer. This tells us that pressure of the air will elevate a liquid to any height providing that there is no continuity of mass. This condition is obtained in the trees by numerous transverse septa in the water ducts which prevent the transmission of air and water in bulk, but permit a very free molecular diffusion of water and everything dissolved in it. This is much aided by the fact that many air bubbles in the water greatly reduce its proportionate weight and make it virtually foam. Sap will always bubble out of a tree wound like so much froth. Much aid comes from the leaves, which absorb the water as it reaches them and transform it into starch, thus creating a vacuum at the top of this internal water system. When a tree is stripped of its leaves for any reason, the ascent of water stops and it is liable to "bleed" at some low point on its trunk.

The gas system is much simpler. The surrounding atmosphere is a great reservoir on which the trees draw for the carbon dioxide so essential to their internal processes. As a waste product, their leaves exhale oxygen. From a man's point of view, trees are atmospheric purifiers.

When the shades of night descend on a tree city, what should be more natural than that artificial light replace the bright rays of the sun? Trees have eyes: that is, they have leaf-cells which not only are sensitive to light but which can sometimes concentrate and reflect light. Thus it would not be surprising if trees occasionally found use for their eyes at night. Yet it would seem that most of the tree-citizens are temperate folk who go to bed with the sun, for only occasionally do they use lights and then most frequently in the quiet depths of the tropic forests where they are most needed. The chandeliers are certain damp and decaying leaves either on the ground or on the trees. The burners are yellow fungous growths appearing as yellow spots on the leaves. The fuel is the leaves themselves and the resultant illumination is a dull and steady phosphorescent glow, varying in colour with different leaves. Certain flowers, as the nasturtium, the tiger lily and the sunflower, also help to illuminate the city with the same kind of flame.

It must be admitted by even the most enthusiastic naturalists that the development of such municipal departments as those of police and fire is very much in its infancy in a tree city. Yet there is often indication of the beginnings of some splendid systems. Individual trees adopt many different kinds

of methods and devices to protect themselves against their enemies, but occasionally there is a concerted move by an entire group or community which looks extraordinarily like the exercise of police power. When we find certain trees in a tropical forest surrounded with a wall of particularly thorny underbrush, it rather looks as though they were definitely warning certain types of destructive animals away. When the persimmon tree, once so common to the western prairies, finds it best to hide itself almost entirely underground or in trenches to prevent being destroyed by hungry beasts, it seems as if a brain power were at work among the plants. Certain other trees exhale poisonous gases. The Germans use the seed of the sabadilla, botanically known as *Schoenocaulon officenali,* for the manufacture of the lachrymatory and asphyxiating gases stored in "weeping bombs." The seeds of this strange and interesting plant are in form and colour like oats, and when stored they emit a piquant smell so strong as to make the eyes water copiously; they also make breathing very painful. These gases are equally painful to animal and insect, and it can unquestionably be said that the plant is using a police if not a military measure. Plants like the gas plant exhale gas all the time—thus the name.

There are whole shelves of fire extinguishers in almost every tree-house of the tree cities. Let a fire start to smoulder among the gutter rubbish of a tree-alley, and at once the ascending smoke and heat detach various leaves from the overhanging balconies above. These, falling to the ground, explode with an energetic little pop as they burn and so tend to both smother and blow the fire out. Their efforts, as in the human parallel, are often unavailing, but it is worth while for them to make the attempt.

Man is the tree city's greatest enemy. With his keen axe and blinded commercial eye he has utterly wiped out millions of leafy dwelling places—not carefully and considerately as one who does what necessity compels or one who even has his eye on his own best interests, but wantonly and with almost diabolical mischievousness. The result is that the United States is becoming greatly alarmed over its available timber supply. A little careful forestry fifty or seventy-five years ago would have guaranteed an adequate supply for all time.

Through the art of sylviculture, man can establish, develop and even reproduce tree cities; and this he can do either by the natural reproduction of trees, or by artificial seeding and planting. The demand for pine flooring and other things makes it de-

sirable and lucrative for him to continually produce lumber, but, instead of reducing some tree city to a barren, burnt-over waste, he can cut the trees on a selective system, leaving the younger ones to reach maturity. Only such precautions will insure the continuance and growth of tree cities, and tree cities are the greatest assurance that man-made cities will continue to grow and flourish as they have in the past.

II

TREES WITH A PERSONALITY

Most beautiful
Of forest trees—The Lady of the Woods.
—COLERIDGE.

NOWHERE are character and personality more strikingly illustrated than in the trees. Anybody who is thrown in contact with them at all soon begins to recognise their individual traits and peculiarities. In fact, it is a question whether some trees do not exhibit more pronounced egos than most animals and quite a few men. Each tree has character, meaning, expression and shows a wonderful power of adaptability.

Despite the fact that to the non-observing all maples may look alike, we all know that the contour, shape, branching and leaf arrangement of each are different. They have racial traits in common, but each is greatly differentiated from its neighbour. They are not cast in moulds like clay pigeons.

Generations of tree longings, aspirations, ambi-

tions and hopes have created in their forms a universal element of nobility and high-mindedness which is excelled by no other living creatures. They quicken our finer sensibilities and purge our thoughts. To be among their sweet-smelling fragrance is to get a breath from heaven, and their playful charm is felt by all in their presence. Perhaps the day is near at hand when we will better appreciate the meaning of the Garden of Eden, and why it was that Adam and Eve were driven from that natural paradise when they had sinned. The forbidden fruit has a marvellous significance which man does not yet understand. In our relation to different trees there is still much to be solved.

The world's history is full of instances when men of great mind and sincere purpose have learned to love some grand old tree exactly as they would a human friend. Poets like Lowell and Whittier had their favourite trees to whom they resorted for greatest inspiration; Joyce Kilmer in his poem "Trees" has shown an appreciation which is prophetic of our future regard for them. One can understand the sentiment with which a dying man recently bequeathed a little circle of land around a beloved tree to the tree itself! Such a bequest may be invalid in the courts, but it is safe to predict that the little iron fence which was erected to carry

out the will's decree and the explanatory tablet nailed to the old friend's bark will not be disturbed for many years to come. Such tenderness is more touching than a million-dollar philanthropy.

Some trees show their personalities by the very places they select for their homes. Willows, mangroves and cypresses which like the damp places of the earth are quite different creatures from the sturdy pines and hemlocks which elect the wind-swept hillsides. Every tree has pronounced tastes not only as to habitat but in colour, leafage, bark, flowers and even perfumes!

Perhaps the most common tree in the northern United States is the oak. Even a man who scarcely knows one tree from another can usually pick out any member of this famous family of wind-buffers.

Most poets award the kingship among trees to "lord of the woods, the long-surviving oak." Many American tree-lovers would have ample grounds on which to challenge this decree, if they based their entire decision on the sometimes scrubby members of the oak family in their home country; but a consideration of oaks all over the world, particularly the splendid specimens of the British Isles, leads to the conclusion that the choice is well warranted.

No other tree is a better embodiment of rugged masculinity tempered by majestic mien. The pop-

lar may evade the elements by inclining upwards, the elm may lessen their stress by arching its back, the willow may even bow subserviently before them, but the oak meets them evenly and squarely like a mighty warrior. It sends massive horizontal branches out into their very teeth. Its knotted limbs and huge trunk bear the marks of many combats, yet when its round, spreading crown is clothed in its mantle of royal green, no human potentate ever made a more courtly picture. Its attributes are age, power, endurance and patience. To these the live oak of the South adds a chaotic arrangement of limbs an artist once described as "picturesqueness gone mad."

The maple has many friends in the human world. Each man is apt to pick out a favourite which comes nearest to reflecting his own character. Many varieties of maple seem to combine sturdy self-reliance with soft gracefulness in an attractive manner. Their trim and compact bodies have a certain majestic femininity about them. We might consider them the queens of the tree world. They show an economical and effective arrangement of their small but comely leaves which smacks of dressmaking. They are the female editions of the oak.

Autumn is their gala season. In their brave gowns of gold and scarlet, no competitor presents

a more brilliant picture. The leaves fall all together as if the maples through over-brilliance of colour had literally burned themselves out.

The elm is typical of the tender and home-loving woman. It is at its best when standing before a lowly cottage door. It is the most easily domesticated of the trees. It fits in equally well on a great meadow, along a quiet road or on a college campus. Unusually symmetrical of line, it is very popular for ornamental uses. Nothing is more beautiful than a street of high-arching New England elms. Their homely yet graceful qualities make them exceptionally appropriate among the haunts of men.

The elm shows a passionate desire for growth and expansion. Its upward, vase-like growth is a symbol of eternal yearning. It is noted for covering its trunk with tender green twigs. The many suckers sent up by its roots are usually destroyed by animals or man's ploughing activities. An English elm is overjoyed when it finds a nearby hedge. Under this lucky shelter it can develop hundreds of shoots which will eventually supplant the hedge itself. If the surplus is cut away, a fine line of full-grown trees will be the result.

Who that is country-bred among us is not unconsciously thrown back into his childhood by the sight of the swaying, feathery top of an elm?

Turbulent streets and noises disappear and are supplanted by hay-filled barns, yellow winding roads and azure-filled rivers.

The wafer ash is a miniature tree, and although it is only six feet in height, it produces a broad, well-rounded head which it proudly holds aloft as if to say, "It isn't the size that determines the power of a tree's personality!" Years ago it gave up the struggle for sunlight and decided to live happily in the shade like its friend, the papaw. This tiny ash thrives from the north shore of Lake Ontario to the southern mountains of Mexico, and its tender regard for the welfare of its children is remarkable. The tiny seeds are carefully wrapped in a closed wooden box, or a two-seeded samara, and upon each side of this little oblong box grows a thin membranous wing, which continues to enlarge until each meets the other and they unite into one wing or biplane which will float away at the least amount of wind. These babies are kept at home until early winter when the winds are strong—then they fly away.

The birch is the "lady of the woods." All the poets agree upon that. With its slender, graceful body, high-flung arms and outstretched hands, it seems like an airy dancing girl poised on tip-toe. Its wild, flowing hair gives it the deceitful beauty of

THE STURDY, WIND-DEFYING YELLOW PINE

THE AMERICAN ELM IS FAIRY-LIKE IN EARLY SPRING

a siren. Delicately white or slightly brown skin enables it to stand out in strong contrast to its more sombre neighbours. The paper or canoe-birch is a tall damsel who stands high and free above her less aspiring comrades, discarding her lower branches as she goes. Birches often show a maidenly timidity about dwelling in the deep woods. They prefer the edges of the forest or the larger open spaces. Yet some varieties have acquired hardy "new woman" qualities which make them strong and adaptable and even carry them to altitudes so high that only the pines are their companions.

Who does not love the righteous, up-standing pine—the puritan among trees? Its rigid tenacity of life among the most extreme hardships of cold and gale arouses all our admiration. Yet it can endure southern heat and drought quite as bravely. With all its frontier austerity the pine has its softer sides. It is the Æolian harp of the forest. Its mysterious and awe-inspiring music forever floats upon the breeze. It is the home of wild doves and wood pigeons. Its strange and fascinating perfume mounts heavenward at all times.

Ruskin describes the pine most exquisitely: "It is trained to need nothing and to endure everything. It is reservedly whole, self-contained, de-

siring nothing but righteousness, content with restricted completion. Tall or short, it will be straight. Small or large, it will be round. It may be permitted to those soft lowland trees that they should make themselves gay with show of blossom, and glad with pretty charities of fruitfulness. We builders with the sword have harder work to do for man, and must do it in close-set troops."

The whole group of conifers and evergreens have very similar qualities. They are all patient endurers of snow and cold—astronomer-like dwellers in high places; sturdy climbers up precipitous slopes. The firs, the hemlocks and the spruces are the only trees with the courage to fling their leaves into the teeth of a nor'wester. The leaves are specially constructed for such hardships. Their surface has been so reduced that they are truly little more than needles off which snow and ice readily slide. Still they do the work for which they were created and add a delightful zest to the winter landscape, besides forming the winter homes of northern birds. A man may think a maple in spring the essence of pure green until he has walked through a snow-decked evergreen forest in January. A more peculiarly delightful sight is hard to imagine. The familiar resinous fragrances are in themselves extracts of health and vitality.

The cedar is another interesting conifer, though not quite so rigorous and north-loving in type. It is possibly the most high-bred and aristocratic tree in existence. In it the dignity of high position and languorous luxury are subtly mixed. A specimen usually dies if a single branch is cut off, as if dismayed by such a personal offence. The peculiar, up-and-down motion of its branches in a wind gives a forceful impression of sailing or floating. Large individuals like the famous Cedars of Lebanon are majestically impressive. The foliage often rises in a series of terrace-like banks.

"By the waters of Babylon we sat down and wept, when we remembered thee,
O Zion! As for our harps we hanged them up upon the willow trees that are therein."—PSALM 137.

The willow is quite another sort. There are many kinds beside the weeping variety and many hybrids, but all partake of that supple, bending grace which characterises the family. It is really too bad that the harp incident of the exiled Jews should have destined the *Salix Babilonica* to weep forever! While the languid droop of the tree's whole outer system of twigs may be interpreted as sorrow, it is also quite possible to see it in a certain serene grace and joy. When a woman hangs her head on her lover's breast she is not sad. She is merely

happy. The willow then should be classified as a joyous and serenely placid maiden, a fit adornment to peaceful river or pastoral domicile.

There is a tradition that all the willows originally came out of the far north. The dwarf willows propagate by sending out underground trailers which send up new stems. This is a common habit of frost-encompassed arctic plants. The herbaceous willow, when growing high upon mountains, often hides entirely underground with the exception of tiny shoots which only rise a few inches above the earth.

We do not hear enough about the beeches. These strong, graceful trees of astounding beauty are veritable Beau Brummels of the forest. Their round smooth bark is the finest overcoat in treeland. Their well-shaped, densely grouped leaves are glossy and glitteringly green. There is a fine delicate tracery among their multitudinous twigs.

Their handsome looks have made the beeches a trifle conceited. While very sociable with their own kind, they usually resent intrusion. They are jealous capitalists who by deep black shadows even prevent the humbler plants from growing in their immediate vicinity. But my, how they dress! The bark fabric which covers their strong, mast-like

bodies is of a shade and texture which stamps it as of the best.

The ash is another handsome fellow, or more appriately, a stately Greek goddess. More than one writer has called it a woodland Venus. Its lofty and well-proportioned strength is suffused with a grace and beauty seen most often in classic statues of the female form. It maintains a noticeable reserve and aloofness quite consistent with god-like attributes. Its bark is of excellent texture with fine vertical lines. The birch is the young and sprightly Aphrodite. The ash is a stately and mature Venus or Athena. Ruskin thought it the loveliest of trees. The ancient Scandinavians considered their ash-tree Yggdrasill the source and upholder of the universe.

The chestnuts are rugged gladiators. They seem to be eternally on the defensive with short, heavy branches spread broadly against the sky. In their militant erectness they delight in sparse clumsy twigs. Their great horizontal boughs sometimes sweep their magnificent five-fingered, accordion-pleated leaves on the ground as if to ward off creeping attacks. The horse chestnut is the most powerful of this group and has all the nobility of its animal namesake.

The sycamore is another warrior—a veritable

giant in stature and all covered over with the marks of many conflicts. Its trunk is very smooth and a sort of pale yellow in color. The serpentine branches are pale grey disfigured with great blotches of white, presumably wounds or rents in a defensive armour. The sycamore is truly majestic in a pristine sort of way. Breadth almost as great as height and a regular system of branching create a feeling of rugged strength. The leaves of the sycamore are delicately scalloped in three-pointed designs.

The poplar is an extremely slender and fairy-like girl who has gathered up her skirts to get clear of the mud. The upslanting character of the branches reaches its culmination in the Lombardy variety, where they almost parallel the main stem, creating the well-known spire appearance. The Lombardy poplar is more like a spouting flame or water jet than anything human. It produces in appearance one of the most startling effects in all treedom, especially when a number of individuals are growing in a line. In winter it becomes a wraith of true spirit transparency. All the poplars are quick growers and short livers. They prefer the open spaces of the earth.

When Tennyson represented Death as "walking all alone beneath a yew," he caught the keynote

of this tree's character. It is the witch or wizard among trees. Its immense columned trunk and symmetrical mass of dark green foliage lend it a certain air of distinction, but one instinctively feels that its deep and sombre recesses are the places for muttered spells and incantations. It seems to be always whispering to itself. The wind sighs and soughs through it. Its plumed and heavy form has a weird fascination. There are many English yews which have attained a great age. The trunk is usually a composite formed by minor stems which have coalesced with the original trunk.

In the tropics, they always think of the palm as an emblem of victory. Its leaves have been used as a symbol of military success from earliest times. It must be at heart a great and invincible warrior. It has dignity, poise and sturdy strength softened by attractive and kingly grace. It embodies a feeling of exultation and joyous exuberance. The various parts of its body are exceptionally serviceable to man.

Every race has its great moral teachers—its prophets, its zealous priests. The tree kind are no exception. The huge sequoias and redwoods have an indescribable religious appearance. They form with their bodies great natural temples which are more awe-inspiring than any man-made cathedral.

With all their terrible majesty, they have a very mild, kindly feeling toward man. Coming, as they do, from vaguely remote ages, they have an air of the infinite about them. Their wood is almost indestructible. A stump thirty years old often shows so little decay that the concentric lines of its diary can still be read.

When walking amid their curiously fluted and buttressed bases, with the sunlight sifting through the leaves above as if through stained glass, men of evil pasts have been known to go temporarily insane through an unspeakable fear and apprehension. To the righteous and clean of conscience the Big Trees bring peace and an inexplicable exultation.

These are some of the more common and characteristic tree personalities. Of others there are hundreds. Each and every tree as with each and every human being has its distinct personality.

The lime is a poetical, debonair little creature, most willing to lend its beauty to the long vistas of English avenues. When the sun shines on its yellow autumn leaves they turn to burnished gold.

The alders and hazels are tree-dwarfs, which for personal advantage have adopted bush-like methods. Their matted roots are of service in protect-

ing the banks of water courses from stream erosion.

The lignum-vitæ is a tropical fairy. Its light-coloured bark, light green leaves and pale blue flowers which peep out in great profusion, give it the airy, spritely aspect of a wood-nympth.

The wild cherry, with its beautiful red-bronze bark, is a miser. It is so niggardly that it cannot bring itself to part with its own dead branches but retains them indefinitely.

The low, broad apple trees divide their strong horizontal branches into a perfect frenzy of little twigs.

The hornbeam is even more perverse and does all it can to tie its branches into knots. When wounded it exudes a sap which turns blood-red on exposure to the air.

The black locust is a tramp and a vagabond. Its ragged and shabby appearance is accentuated when winter winds strip it of its leaves.

The study of trees quickens our love for them. It is not necessary to learn their scientific names, the peculiarities of their bark and their leaf structure, in a dry, school-boy fashion. The best way to know a man is to get acquainted with him. We do not worry about the height, weight and exact

racial extraction of our friends. Knowledge of these things comes through the association of many years. In some such way we should get to know the trees and their personalities.

III

TREE PHYSIOLOGY

Full in the midst of his own strength he stands,
Stretching his brawny arms and leafy hands,
His shade protects the plains, his head the hills commands.

—VIRGIL.

ORDINARILY no one thinks of saying that a tree is structurally or organically like a man. In fact, we do not often worry about the functions of a tree's body at all; we think of it as "just growing." A man has a heart, a stomach, a liver and a score of other components which are always getting out of order. A tree has none of these, yet it has some very definite organs which perform miracles in the transformation of matter quite as capably as the human variety. Like ourselves, the trees draw upon substances about them to build up a bodily structure of marvellous permanency and efficiency.

A tree is a little lacking in nerves and highly specialised internal organs but it has parts which perform their functions. For one thing, it has a

very definitely developed skeleton. One would be inclined to say at first thought that a tree was all skeleton. The great mass of a tree trunk is composed of hard, mineral-filled cells in which life is extinct. They form the great bone-like structure of heartwood which holds the tree aloft and endures for long periods of time.

Surrounding the heartwood from the tiniest root to the highest branch is the one vital and vulnerable organ of the tree: the cambium layer. This interesting tree organ is a slimy and colourless group of wood cells which covers the entire plant like an undergarment. It contains within its protoplasm the vital life principle. Here is where all growth takes place. It is muscular and nervous systems combined. Girdle a tree so as to expose the cambium layer and everything above the wound will die.

The delicate cells of the cambium layer propagate by division. On one side they produce sapwood, which for a few years is used for the circulation of liquids and the storage of starch, but finally through continual accretions of mineral deposits solidifies into heartwood. On the other side, they add bark which is the tree's outer skin.

The sap is of course the tree's blood. As a medium of circulation it carries absorbed water and

minerals up from the roots to the leaves, where by a digestive process they are chemically transformed to meet the tree's needs. This material is then distributed as required or stored up by certain cells for future use. Tree blood often contains substances valuable for the use of man. He does not hesitate to appropriate large quantities, but, luckily, a tree does not bleed to death as easily as a human being.

The bark we have already alluded to as tree-skin. It covers and protects every square inch of the tree's permanent body. Without it the cambium layer would perish. It is impervious to the passage of water and gases except through pores called lenticels. The mouths of these are fitted with cork filters which makes them hard to see except on very young branches. Through the lenticels air is admitted and withdrawn from the cambium layer in a sort of respiratory process. In the absence of the leaves the bark also carries on the work of transpiration, which is similar to perspiration in man. Bark is composed of dead wood and cork cells which under expanding pressure crack into the characteristic plates which are such a great help in identifying trees. In the cork oak from which we get our commercial supply, the cork grows to a remarkable thickness and can be taken

off every eight or ten years without injury to the tree.

A tree is many-mouthed. Its immense system of roots, often as extensive as the portion above ground, is engaged in the sole business of sucking and drinking in nutriment from the soil. Botanically, a root is that portion of the plant axis which does not bear leaves, normally grows downward and is fixed in the soil. It is simpler in form than the aerial branches, and is irregular in its method of division. The growing point is just back of the tip of each rootlet. At the tip is a sort of protective shield or cap which the expansive power of cell division forces through the earth much as tunnel-diggers bore their way along. Still farther back from the tip are the root hairs, long hollow single cells which absorb moisture from the surrounding soil by capillary attraction. In this moisture is dissolved valuable mineral salts essential to the tree's economy.

In many ways the leaves are the most wonderful parts of the tree. They are stomachs and lungs combined. Out of crude sap, with the assistance of air and sunlight, they elaborate plant food capable of assimilation. At the same time, they breathe out through their stomates vast quantities of water and other waste products. They are really thin

WHERE CYPRESS TREES RISE ABOVE THE WATER ON ROOT-STILTS

A NEW JERSEY TREE WHICH HAD ITS BACK HOPELESSLY CRIPPLED IN YOUTH BUT WHICH STILL GROWS GAMELY

sections of the vital cambium layer which courageously come out into the open to perform certain vital duties.

On a clear bright day each leaf is a busy little factory for the manufacture of starch. The sun furnishes the motive power and the air and ascending sap the raw materials. Carbon dioxide from the atmosphere is the main ingredient. It is cleverly combined with sap-water to form starch. The combination $C_6H_{10}O_5$ leaves a surplus of free oxygen which promptly passes back into the air through the stomates. This withdrawal of CO_2 and the substitution of oxygen is an important purification of the atmosphere from man's point of view. With the oxygen, vast quantities of water are also liberated, except in very hot weather when the closing of the elastic curtains or doors of the stomates makes for the conservation of this important substance. On an ordinary day, when plenty of moisture is to be had, a medium-sized oak will evaporate 150 to 180 gallons of water.

The minerals in the sap aid but do not enter into the starch-making. Carried to other parts of the tree, they are vital factors in construction work. With the setting sun, the green leaf-laboratories shut down.

On the approach of winter, the leaves undergo

a remarkable change. The tree withdraws into its interior the carbohydrates and the albuminous substances composing the leaf-pulp. The chlorophyll or green colouring-matter changes chemically to form, with deposited iron and other minerals, the bright colours emblematic of the season. The leaves grow shrivelled and unattractive until the corky rings at their bases finally give way and they fall. What little substance of value they contain goes to enrich the soil below. Next year the tree will have a whole new set of lung-stomachs.

Leaves of a few tree families indolently remain on the boughs all winter. They are there by sufferance only and serve no needed purpose.

The flowers are the trees' organs of reproduction. All trees have them, though in some they are in the form of inconspicuous catkins which are liable to be overlooked. On the other hand, many tree-flowers, notably those of the edible fruits, are as luxurious and beautiful as any garden favourite.

Most trees are bi-sexual. They bear flowers which contain both stamens and pistils, or produce blossoms which though individually of one sex occur in both male and female form on the same tree. The stamens manufacture the floury pollen which is conveyed by wind or insect to other trees. The pistils receive visiting grains of the male element,

which, descending into the ovaries, add to the tiny ovules the principle which will make them potential trees. Whenever self-fertilisation occurs, degeneracy is the usual result.

Scientifically, tree-flowers are modified leaves. Besides the pistils and stamens each one is made up of a calyx, an outer cup-shaped organ, and a corolla or flower proper, which is nearly always divided into petals.

A tree-fruit is a ripened pistil. Fruits are sometimes the product of a number of pistils contained in the same flower, or even of a cluster of flowers. In many trees, the fruits are small and of little food value to man. Occasionally, a tree covers its seeds with generous gifts of juicy and attractive pulps. These fruits become of the highest interest and by careful cultivation are made to attain their maximum development.

It is a profound thought to realise that the largest and most majestic tree was once a tiny seed. In that insignificant offspring of vegetable life was the vital principle which was in essence a tree. The growth and development of the plant was a mere setting in motion of a structure and an organisation already possessed.

If we examine the embryo forest giant, we find that, in most cases, it contains a radicle or germ of a

future root, a plumule or incipient stem and a vast quantity, comparatively, of food material. This is in the form of cotyledons or fleshy leaves. They are nearly always two in number which classes most trees among the dicotyledonous plants. A few trees have monocotyledonous seeds. This would be an unimportant distinction in itself, were it not that these facts foretell certain styles of structure and growth.

Tree-seeds which have left their parent tree in the fall, remain quiescent all winter, usually a few inches below the surface of the ground. Under the quickening influence of spring latent life stirs within them. Their entire bodies are covered with tight little water-proof jackets. Their only communication with the outside world is through a little window or door called the micropyle, which means in Greek "small mouth." Therefore, their first action is to drink in large quantities of water through this micropyle. This makes them swell prodigiously and eventually burst their enclosing walls. In the meantime, the radicle, feeding on the starch stored in the cotyledons, has passed out through the micropyle and started on a downward search for nourishment. With the seed-walls burst, the little plumule, often with a tiny leaf already developing, pushes its way to the surface. Some-

times it carries the shrinking cotyledons with it, where under the influence of air and light they turn green and perform the functions of leaves until more permanent ones can be formed.

The seedling is now well started. Growth goes on rapidly. Branches are thrown off and buds and leaves formed. If we cut the stem of a young seedling across, it seems to be composed of a loosely packed pith and an epidermis. Examined more closely, the outer portion of the pith is seen to be more solid in texture. It is the beginning of the future wood. Between the outer and inner piths lies a bundle of longitudinal strands, the future cambium layer.

By the end of the first year the young tree has taken on its permanent form on a small scale. In structure it is composed of the main stem, branches, shoots, leaves and buds. The points of growth are at the tips of each branch or shoot. The tree also grows in girth throughout its body exogenically or by development outward. The branches group themselves in definite arrangements. The points where leaves appear are called nodes. The stem-spaces between the nodes are internodes. Some of the branches are observed to be rudimentary and destined never to develop. This is due to the ever-present tendency of the sap to mount as high as

it can. This habit often causes the lower branches to be neglected, especially when the tree has become very tall.

The buds are most interesting. Each bud has the remarkable power of being able to reproduce everything which has so far been grown on the tree: stem, branches, foliage and fruit. It differs only from the seed in remaining attached to the tree and finding it necessary to stay there to perform its work.

Each summer the tree forms the buds destined to "germinate" the following spring. Each leaf of that year has an incipient bud in charge. If anything happens to a leaf its nearby bud usually dies. During the winter even the thick coats of the buds cannot keep out all the cold, particularly as trees differ from animals in having no internal heat. As a matter of protection the water in the cells composing the buds passes by osmosis into the intercellular spaces. Here it may freeze to its heart's content without bursting any cell walls. Fruit crops are destroyed by early frosts because the water is caught in the cells instead of out of them. Freezing, it bursts innumerable delicate membranes and disintegration results.

The ascending sap of spring brings nourishment to the buds. They burst through their scales and

unfold their miniature shoots. Sometimes the scales grow along with the buds to protect them for a while. Eventually they always fall.

A cross-section of the trunk of a mature tree is very simple in arrangement. At the very centre is a very small amount of pith which radiates out in all directions as the medullary rays. These pith-rays are serviceable in the movement of sap, both longitudinally and laterally. Surrounding the central pith are concentric rays of heartwood, corresponding in number to the tree's age and composing the larger part of its mass. Life is extinct in its cells. For a tree to be "rotten at the core" is really not a vital thing. The central wood is dead already. Only when the decay approaches the living cells near the circumference does it become alarming.

Surrounding the heartwood is a region of sapwood, comparatively new cells which are gradually solidifying into heartwood. Next is the active cambium layer, which we have already discussed at length. Surrounding everything is the bark.

This stem formation extends throughout the tree except in the smallest twigs where the area of pith is greatly increased.

In one aspect, a tree is a great community of little plants. Instead of the polypi of the coral,

the tree has thousands of leaves and flowers. These little parts of the whole are continually running through a cycle of infancy, development, maturity and death. Over all and embracing all is the great life cycle of the entire colony. The tree must continue to grow to live. As soon as it stops, decay and ultimate dissolution set in.

IV

TREES THAT ARE FASHIONABLE

Through the grey and sombre wood
Against the dusk of fir and pine,
Last of their floral sisterhood
The hazel's yellow blossoms shine.

—WHITTIER.

OF all well-dressed beings, the trees are the nearest approach to fashion-plates. They are always attired from crown to roots in perfect taste. Though young and scraggly or old and wind-racked, they still display a certain harmony and beauty of costume not seen in every part of the plant world. Tree-flowers are of many shapes and colours, yet they invariably fit in perfectly with the colour scheme of the bark and leaves. It is as if the trees had a private key to the bandbox of nature, and used the fairies as dress maids.

Most men and all women make four general changes of costume each year. So do the trees. In fact, there is little doubt but what the trees were the innovators, as they have lived ages longer on

this planet. Not only do we imitate the trees in ordering approximately four suits a year, but we fully copy the tree colours and patterns when we make them up. Trees also have a tremendous influence over all human conceptions relating to the seasons.

Trees are somewhat vain of their costumes—in some cases, may actually be said to pose for their pictures. It is not uncommon to find in certain districts of the West specimens of moss agate, bearing on its face the perfect figure of a tree. So detailed are some of these tree pictures that the exact species may sometimes be determined. Who shall say the tree did not stand for its portrait? Should certain trees like the pinion become extinct, their likenesses will be forever retained in the moss agate.

The life of a tree is a never-ending cycle, though it is customary to think of spring as bringing a new birth and a new awakening to all plant kind. The trees are quiescent in winter but hardly asleep and by no means dead. They are likely planning their spring dressmaking; for, like fashionable women, they each must appear in the latest models at the desired time. Our Easter preparations for new hats are nothing compared to the preparations among the trees! Here every one turns milliner

and dressmaker and even the male trees are interested. Powders, frills, flowers, perfumes, rich colours—all these are utilised afresh each season.

Many of the tree-buds which have been formed the summer before have been wrapped in oilskins all winter. Their sticky, varnished surfaces have kept out every vestige of moisture and cold which has come their way. Others have achieved their purpose with beautiful fur coats of delicate look and texture. Then there are those which appear in the thick, hard garb of workmen. Not a few wear overcoats of the close-fitting military type. The buds of the forsythe, an exceptionally early spring shrub, always have clothes of ample dimensions in order to facilitate their quick enlargement during the first January thaw.

Most of the buds begin to swell in March. The resulting addition to the landscape of dull crimson, purple, olive, and silver produces a beautiful effect. The bursting buds of the cultivated magnolia give the impression of blood, while the tiny brown buds of the elm look like sleeping insects. The tree-masses are still dark brown and grey, but there are subdued shades of brighter aspect running through them.

When the trees finally decide to throw off their winter clothing, they do it with an abandon and

éclat quite akin to the way in which most women don their spring millinery; yet nature keeps no old feathers or ribbons to trim her new coats and hats. It is as if the world had gone colour mad overnight. The wind has awakened all the trees and the bursting buds open and send forth myriads of delicate and exquisite flowers. The apple, the cherry, the peach, the plum, in fact nearly all the fruit trees, are quite lavish in their displays. On the other hand, many of our shade and forest trees, such as the oak and the maple, are so modest in their efforts that we hardly realise that they are flowering. Their blossoms are well-formed and daintily coloured, but they are so small and inconspicuous that one rarely sees them. Not a few trees, like the poplar, arrange their flowers on long, pendulous chains which we call catkins. Sometimes the male or staminate flowers are separate from the female or pistil-bearing flowers and again they are merged in one.

Tree-flowers are as varied in their form and colouring as the boughs which wear them. Each family of trees has a fashion all its own; just as each nation of people has its own peculiar style of dress. The tulip-tree and the magnolia are especially showy and yet they have a certain air of military precision. The sassafras and ash are cold, firm,

and dignified; the sycamore is proud and haughty, with an air of a grandee about it; while the weeping willow seems to be a tree of deep emotions, whose delicate branches vibrate to every breeze. The silver poplar bears beautiful little cup-shaped flowers.

The silver fir is a very artistic dresser. Its close-fitting costume of refreshing green, ornamented with beautiful brown cone-buttons, is very appropriate for the high mountain altitudes at which it lives.

Some of the tree-flowers discard or throw to the ground the warm bud-overcoats which have sheltered them during the winter. More thoughtful ones merely turn them back as a man does a collar and thus create for themselves a pair of stipules. Others, like the fast disappearing catalpa, are so extremely artistic that they carpet the nearby ground with their exquisite little flowers of yellow and purple during the flowering season. Nothing is more beautiful than earth strewn with catalpa blossoms.

It seems a strange thing that most of our trees should blossom before they come out in leaf, yet like many of the apparent anomalies of nature, this fact has its foundation in necessity and convenience. A great many trees depend upon the

wind to aid them in their love-making. It is this agency which carries the pollen from tree to tree and so makes reproduction possible. The courtship of trees is brief and beautiful. With the trees in full leaf, the flight of the pollen would be almost entirely arrested and the species would be doomed to premature extinction. With most trees the function of the flowers is over just as the leaves are getting into a good stride; nature does only one thing at a time. You may have wondered in early spring to see the ground under certain trees strewn with catkins and even vaguely regretted the storm which has cast them there. The fact is that they have already done their part, and are no longer needed.

It should not be imagined, however, that the flowering of the trees is confined to the months of March and April altogether. Mother Nature, as if to distribute her flowers evenly throughout the seasons, has caused some of the trees to postpone their blossoming until late in the spring, summer, and even fall. The witch-hazel blossoms very late in the fall, long after the purple asters and golden-rods of autumn have appeared. Though the elms and dogwoods blossom quite early, the linden waits until late.

When great masses of bright green leaves fill

SILVER FIR. *Abies Fraseri.*
This tree ornaments itself with beautiful brown cone-buttons.

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the landscape, spring may be said to have come to stay and the trees exhibit their seasonal wardrobe complete. The green specks of brightness which flecked the dark brown branches of the elm have become gorgeous curtains of full-grown leaves. The horse-chestnut shows lusty green leaf shoots and the larch has clothed itself from those first modest effulgences which looked like moss. Even the conifers have thrown out fresh yellow-green leaves on the tips of their blue-green branches. The pink boughs of the redbud have put on green, and the dogwood has dressed itself in rough grey leaves. All these are really summer outfits, as the trees wear them right up until the end of September. The colour darkens in tone, but it still remains a refreshing green, a god-send to heat-stricken man.

> The mountain ash,
> Decked with autumnal berries that outshine
> Spring's richest blossoms, yields a splendid show
> Amid the leafy woods.
>
> —WORDSWORTH.

So the fall of the year approaches—the time when the trees become futuristic in thought, and nature, mixing her pigments with a master hand, creates colour schemes which no human brush can simulate. Matter-of-fact chemists tell us that the wizardry of autumn is due to the breaking up of

leaf-chlorophyll (green colouring matter) into xanthophyll and erythrophyll, but that is a bald and prosaic way of putting it. We prefer to think that the trees are tired of the heat and the indolence of summer and wishing to celebrate the advent of more tolerable weather, put on their gayest and gaudiest costumes. Gaudiest? Well, that is hardly the word. While an individual leaf often looks very garish when viewed by itself, it becomes eminently proper and sedate when put back in the general scheme from which it was taken. A group of the most brilliant autumn trees imaginable looks very quiet and respectable as seen from a little distance. Despite all the reds and yellows, the prevailing autumn note is brown. Man has recognised this in his adoption of brown as the colour-symbol of fall, just as green forever typifies the spring.

The individual colours are there, if you pick them out. Who can adequately reproduce on canvas the crimson and bronze of the oak, the champagne of the ash, the amber of the chestnut, the scarlet of the swamp-maple or the bright chrome of the beech? These shades are all laid on the dark green background of those trees which are slow to yield to frosty influences, as well as the pines, spruces and hemlocks which wear blue-green coats all the year. It is interesting to note that in the matter

of autumn colouring, Mother Nature allows her tree charges more or less of a free hand. Acorns are the same the country over, but the oaks from which they fall run through a series of different colour shades. Individual trees develop colour idiosyncrasies. Certain branches on particular trees have been known to elect some striking or unusual shade of red or yellow year after year. It has been suggested that some clever grafting experiments might produce autumn tree-clothes which were truly startling.

It is customary to think that with the fall of the leaves, beauty and charm depart from northern landscapes. Only people with a very primitive idea of beauty can look at it that way. Just as the undraped human figure reveals grace of form and line more divine than any amount of adornment could give, so the trees reach their highest development of beauty when divested of their leaves. There is a delicacy, an airy grandeur to a winter landscape which far transcends the luxuriance of summer. The nude trees remind one of exquisite sculpture; even the muscles and bones can be studied and appreciated. The rich leafage and strong colouring of the earlier season seem almost voluptuous when compared to the esthetic classicism of the snowy months. The winter woods depend for their beauty

on the strong, underlying elements of structure and line, with a resulting charm of a purer and higher kind. Of course, the evergreens—such as the cedar, fir, and pine—and a few trees which decorate themselves with mistletoe are charming exceptions.

This is not a mere matter of artistic insight. Any one can see the beauty if he but take the trouble to look. There is a wonderful richness of tone in the browns and greys which make up the masses of the distant woods, and here and there a birch gleams white, or the evergreens add marvellous touches of green which are more beautiful than anything spring can offer. Faint mists of colour in combinations of violet, rose and soft grey hover over the thickets. A thousand branches lift a delicate tracery against a neutral sky. When the snow covers the hills and valleys with a carpet of chaste white, nature has made her supreme effort to portray the ideally beautiful.

You cannot get to know the individual trees aright until you study them in winter. The bare limbs bring out all their traits and foibles. The essential details of shape and framework are displayed without reserve. The oak shows boughs of sturdy strength. The elm runs up into half-arches of tapering filaments. The beech has a smooth, clean-springing bole of vast proportions and what

Thoreau calls a "handsome instep" where its great roots grip the soil.

The structural reason for the foliage-masses of the different trees is quite apparent when one has seen the skeleton of each. The few large branches of the oak naturally make for grouped masses of leaves with contrasting shadows and deep, cavernous openings. The numerous slender branches and side-shoots of the maple account for the smooth, sunny surface of the leaf-clothed tree. The framework of a tree determines whether its ultimate expression shall be one of gloom, dignity, or grace.

The bark is both the skin and the winter overcoat of trees. Each tree chooses a material with a pattern and texture suited to its own particular style of beauty. The beech is a hardy creature who wears an outer covering which is wonderfully smooth and fine, but which is so thin that we wonder how he keeps from freezing to death. The walnut and the pecan wear close-fitting coats of a considerably heavier weight. The sycamore is content to appear in a winter habit so rough as to seem ragged. The birch is decidedly fashionable and sports clothes of startling cut and colouring. She often wears overlaying parchment suits of white, amber-yellow and garnet-red. The red oak wears a beautiful pink

union-suit. All tree-clothes are both air and water proof.

When it comes to frills and foibles of dress, even the best gowned ladies must stand aside. All their fads and fancies have a counterpart if not a prototype in treeland. The idea for many a hat or cloth-pattern is originated by some smartly dressed tree. The southern species, especially, love to adorn themselves. Some, presumably males, swing aerial branch walking canes from half-bent arms. Others, more than likely females, flutter vine festoons in the wind in lieu of ribbons. The trees along Florida's St. Johns River deck themselves with Spanish moss as with a bride's veil. Certain tropical varieties wear great orchids in their bosoms, or make their own perfume. In the tropics, not a few wear the stiffest form of corsets. They are sometimes so laced up with vines as to be half strangled.

Temperamental trees often harbour frogs, lizards, crickets, and katydids for musicians. No doubt the strange fad of some years ago which tempted society women to wear live lizards on their neck-chains was started by some tree belle. The grand-daddy greybeard tree wears an immense beard in the form of long grey threads which are in reality its blossoms; these threads look for all the world like the grizzled whiskers of some aged

IN SPRINGTIME THE HORSECHESTNUT IS THE MOST GAILY ATTIRED OF TREES

THE SOUTHERN LIVE OAKS DECK THEMSELVES WITH A BRIDAL-VEIL OF SPANISH MOSS

man. The buttonwood tree prepares its seeds in the form of buttons, while its leaves are not unlike coat tails of sheer and fine material. The pines produce leaves which are tassels, while the tulip tree has its seeds in the form of exquisite brooches. The palm grows large and graceful hands with which to fan itself. The flowers of the horse-chestnut look like aged inebriates, while its five-pointed leaves stand out like grasping hands. The white blossoms of the black haw gleam through the dusk like white teeth or tiny eyeballs. The mangrove tree defies all etiquette by lifting her skirts high above her knees as she wades in the water. Perhaps it was from the mangrove that women first learned of rainy-day skirts!

The trees follow the fashions of their own particular kind or set but are quite disdainful of those beyond the pale. Most of them consider it stylish to be small around the waist, but the swamp cypress deliberately sticks to the old fashion of hoop-skirts and bustles. The weeping willow strives for grace and daintiness, waving her branches to and fro in every wind. The shell-bark hickory prefers to stand up stiff and unyielding and hold his arms at abrupt and unshapely angles. The Norway maple is of the massive, solid type. The Lombardy

poplar stabs the sky-line like a slender exclamation-point.

In the use of colour there are of course marked differences. The oaks and maples have a corner on the vivid autumn effects, while such trees as the birches, ashes, and poplars go in for softer tones. Even the maples are by no means agreed as to the correct shade for October wear. The Norway maple seems to prefer oranges and gold, while the sugar maple usually picks out different blendings of red and crimson. These colour schemes are worked in material of different textures. Viewed from a little distance, some trees have a foliage-dress which looks coarse and dense with deep and sombre shadows. Many more wear clothes which have a light and elegant look.

The fashions and caprices of trees have wielded a larger influence over man's history, since his original short stay in the Garden of Eden, than he is consciously aware of. Since Mother Eve first draped herself in fig leaves, mankind has imitated the tree fashions. Among other things, the trees were the first to originate the relation of colour to the seasons. Man gets his ideas of colour-symbolism from them.

V

TREES WITH A COLLEGE EDUCATION

The poplar that with silver lines his leaf.

—COWPER.

TO-DAY no man is so poor but what he can go to college. In the great school of nature every tree receives an education which at least carries it through the secondary grade. To man is left the privilege of adding to, or of aiding in, the university training.

If experience is the greatest teacher, then the trees are well drilled. The primal forces of the universe are the stern masters before which they sit. Not a day goes by but they are forced to learn a new and difficult lesson whether they care to or not. Long centuries ago the pine discovered that it was perfect folly for it to flaunt wide flat leaves in the death-dealing blasts of winter. To save itself from being blown over by the first hurricane it was forced to reduce its leaves to long green needles which offered little resistance to the air pressure. The persimmon tree found that it could

best get along by hiding largely underground. The hazel and other trees considered it advantageous to adopt the habits of bushes. The great red oaks of California found that they could only afford to grow in large groups and thus protect their huge bodies from the storms. The pine of the north became the palm of the south. So it goes. Every species of tree in existence is the direct outcome of nature's class room work. And the term never comes to an end.

We are too apt to look upon evolution as a thing of the past—the process by which things arrived at their present status. The laws of natural development are just as much in force to-day as they ever were, only we cannot expect to see in a single lifetime or several of them, results commensurate with the changes wrought by centuries of patient effort.

Every tree, like every worthy man, strives to fulfil the highest and noblest destiny which the limitations placed upon it will permit. A tiny seedling pushing its way up into the dark, dank atmosphere of some overcrowded forest is doomed to death before it is scarcely born. A pine growing on some rough, exposed hillside can never attain the symmetry and luxuriance of form possible for its fortunate brother of the sheltered forest reserve. But each tree can strive to do its best, and

they all do. Would that men were so courageous!

Some trees, like many men, never get beyond the necessity of struggling for an existence. Competition is so keen and the distribution of natural as well as human wealth often so faulty that whole groups of trees are forced to live in the slums of plantdom. Hunger, cold, and the buffets of a remorseless world keep the pinch of poverty constantly upon them. They never get beyond the bare essentials of existence and must leave the development of the beautiful and esthetic—in other words, the cultivation of the fine arts—to more fortunate tree-citizens.

On the other hand, propitious circumstances of the past have brought about a race of tree aristocrats, plant beings of strong physique and heredity, who are free to develop all those elements of beauty and nobility toward which all trees strive. The stately elm, the sturdy oak, the spreading chestnut —these are some of the first families, though prosperous individuals of other stocks often attain great prominence. It is these trees which may be said to attend the College of Nature, where they learn all those gentle graces and accomplishments which make up the best in plant civilisation.

Many trees go higher and take a post-graduate course of marvellous efficiency. Strange to say,

it is at a university conducted by man. He trains them largely for the bountiful tuition they pay, though sometimes he does it out of pure love for their beauty and companionship. With his marvellous knowledge of the laws which govern tree life and his ingenious faculty of adopting means to ends, man often makes wonderful progress with his passive charges. He heals and cares for their bodies better than they ever could themselves. By his universal domination of the plant world, he secures for them that freedom and advantage of environment which enables them to bring their inherent abilities to full fruition. He even works upon the very fundamentals of their existence and so shapes and improves their life-streams as to bridge in a few years the gap in development which natural evolutionary processes would have taken ages to span. Subject, yet lord, of the laws of nature is man.

Consider the hospital department of man's Tree College. Humans are in a position to give the trees an immense amount of medical help. The more the tremendous economic and esthetic value of the trees is realised, the more is man, for his own interest, apt to look after their physical welfare. Yet he is only beginning to appreciate his duties in this field. Too often one may see a large spreading

tree in somebody's front yard with a great ugly cavity eating into its vitals. The owners are sympathetic but passive.

"Isn't it too bad?" they say. "I suppose we shall have to chop it down before long."

Sometimes it would seem that human life has become so sacred that the lives of fellow animal and vegetable organisms have become of less account by comparison. The owners of a sick tree are quick enough to repair a hole in their piazza, but are either unaware of or indifferent to the fact that a little cement and a skilled hand can close up the ugly tree-wound and add many years to the invalid's life.

Old trees are often allowed to perish unnecessarily when a little judicious pruning might have prolonged life for a century or two. Death usually comes from a gradual failing of vigour due to insufficient nourishment or to internal decay. Withering of the top branches is the first sign. Health can be restored by shortening all branches one-third or one-half, which insures a greater and more vigorous leaf surface.

Trees suffer from many diseases which man can alleviate. The fact that many oaks, chestnuts and beeches live to be two hundred years of age, while fortunate specimens survive a thousand years, in-

dicates that their shorter-lived fellows have succumbed to adverse conditions of some kind. Among the things with which they contend are uncongenial environment, mechanical injuries, insect and fungous enemies, and physiological troubles.

It takes an expert in tree pathology to correct some of these ailments, but others can be detected and done away with by the untrained eye and hand. Even a city-bred man knows that caterpillars are not exactly a benefit to the foliage of a tree. When they, or any other insect pest, become too numerous, the tree should be sprayed with a death-dealing chemical. In California they often fumigate whole fruit orchards with some such gas as hydrocyanic (prussic) acid. Companies organised for the purpose will undertake to rid a whole group of trees of their insect enemies for twenty or thirty cents a tree. The work is often done at night, and a common method is to drop a canvas tent over each tree, within which the deadly fumes are generated.

If a man has a blood-poisoned arm the doctors cut it off. In the same way dead and decaying limbs should be removed from trees. If a man has a weak or injured leg he is given a crutch on which to lean. It is only fair to help the trees by providing bolts and supports for their weak members. Moreover, these surgical helps should be

given with some degree of thought and care. No one would think of chopping off a man's leg and then turning him loose to get along with the bleeding stump as best he could. Yet that is just the way some people attempt to doctor trees. A wound of this kind should be carefully cauterised with tar but not with tin or zinc. In bolting it is best not to employ iron bands which encircle the limbs, stop the circulation and retard growth. Drive the bolts clear through each limb and hold with a nut on the opposite side. An ideal way is to have two bolts held by a turnbuckle in the centre. This allows the limbs more play and does not hold them so rigid against the wind.

In some respects a tree-cavity is like a cancer eating into the vitals of its victim. More accurately, it is like a cavity in a human tooth, as its operations are carried on in the hard, bone-like interior wood. In either case, it should be thoroughly cleaned out before filling. When the rotten wood and fungus have been removed, the interior should be washed with some antiseptic solution (copper sulphate will do). It is wise to drive nails part way into the inner walls to help hold the concrete. The filling should be finished a little below the level of the outer bark in order to allow it to lap over.

It pays to put careful work of this nature in the hands of a tree expert.

Nature is sometimes her own physician, and, when her ills are not too severe, can cure herself without consultation. Her surgery is bloodless, and, as far as we know, painless. Poplars and willows sometimes become too ambitious, and, in the stimulation of spring, send forth more twigs and branches than they can support in the sluggish days of summer. Finding themselves with a surplus of twigs, these ingenuous trees perform a number of amputations. By a special cell formation of cork-like growth the nutrition is gradually cut off from the part to be eliminated. These abscess cells, as they are termed, form up close to the parent limb or trunk and completely encircle the branch to be discarded. When the cork circle is complete the twig drops off by its own weight.

There is no question but that, as a class, the fruit trees are the best educated members of their race. Because of the delicious tuition they are able to pay, man has made them his class-room pets. They have been very apt pupils and in his skilful hands have undergone many marvellous transformations. We are in the habit of thinking that it must have been a very luscious apple indeed which caused Adam and Eve to sin. Yet all the findings of

EDUCATED DATE PALMS WHICH HAVE ATTAINED UNUSUAL LUXURIANCE

THIS CURIOUS TREE SHOWS PURPLE BEECH GRAFTED ON AMERICAN BEECH

science would indicate that the apple of the Garden of Eden was a small, unattractive fruit more tart and bitter than our modern crab variety. The fact is that only in the tropics do edible fruits grow spontaneously. In temperate climates the trees' energies ordinarily are so taken up with providing the means of subsistence that the fruit is of a very small and mean variety. It is only when man takes the tree into his class room and by careful nurture and intelligent guidance of its evolutionary processes creates ideal conditions do the fruits as we know them develop. The tart wild cherry becomes sweet and luscious and five times its original size. The bitter wild grape becomes a beautiful Concord cluster. The hard, puckering crab apple becomes the resplendent globes of deliciousness known as golden pippins.

The principles of education as applied to fruit trees are very simple. By abundance of water, soil and sunshine each individual is given the best possible chance to develop itself and the best specimens are selected for propagation. By cross-breeding, budding and grafting nature's laws are hurried toward the goal which has been decided in advance. In fruit culture it is always an object to diminish the foliage and the size of the seeds in order that greater strength may go into the growth of the

fruit pulp or flesh. The older and more feeble a tree gets, the more its fruit is likely to return to the wild state. Naturally, the tree-teachers have a great variety of ways of applying the principles of fruit culture. One may cross-breed by dusting the pollen of one tree upon the flowers of another. Some authorities maintain that peaches only reach their best development when grafted on plum branches. A third will stake his reputation on cuttings or the setting out of twigs. Whatever the method, it should be pursued in love and patience.

It is said that apples, pears, plums, cherries and quinces stand grafting unusually well. A common method is to insert two small scions or twigs in corresponding splits in the stump of a small branch on the tree selected to become the new foster-parent. The wound is carefully sealed with wax. If both scions grow it is better to divert all nourishment to one by cutting off the other. Budding is carried on in the same way, except that buds instead of twigs are used. A layer is a branch buried in the ground but still attached to its tree. From it new shoots take root.

It is recognised that all teaching requires the use of the intuitional and instinctively selective factors in a remarkable degree. This is especially true of tree-teaching. Why is it that Luther Burbank

has become such a wizard with all growing things? It is because he has a wonderful psychic sympathy which enables him to interpret their needs and desires and so train and direct their activities that they are able to accomplish in a few years what would have consumed a thousand years of untutored striving. Out of a hundred apple trees, Burbank selects but one to carry on the destinies of the race. An acre of berry bushes is burned to give way to the offspring of one of their number. Burbank is the greatest plant educator of the age.

While some of his more extensive operations have been in other fields, the California naturalist has accomplished some marvellous things in tree education. A number of years ago he produced the fastest growing tree of the temperate zone. It was a walnut and in thirteen years grew to a size equal to that of the average twenty-eight year old of its kind. At the same time he reduced the thickness of the nut shells to that of paper. While this was convenient for man, it was quite agreeable for the birds also. They pecked through so many of them that Burbank promptly bred a new tree with thicker shells. The meat of these nuts was white and all the bitter tannin was missing.

It was Burbank who created the plumcot, a delicious new fruit, a combination of American and

Japanese plums. He also created a plum which tastes like a pear. A certain group of chestnut trees under his training learned to bear fruit at the age of eighteen months. He has improved the quality of many apples.

When man educates the trees in great natural groups we call it forestry. It is in reality a great tree university. In one sense man is conserving the woodlands for his own use and purposes, but at the same time he is a servant of the trees and is aiding them to reach their own highest development. He sees that the young trees have adequate air and light. He protects them against fire and even risks his own life to save them. When sufficiently progressive and enlightened, he removes such trees as he requires for his own use in a sane and scientific way. Instead of cutting down whole tracts and even wantonly burning over the denuded areas, he thins only those trees which have reached marketable age. This is called selective cutting and man soon finds that it pays him in hard cash to give the trees a square deal. The rule is to cut each year in a given area only a number of feet equal to the estimated annual growth. Instead of using up the forests and subjecting the country to all kinds of calamities, this maintains the woodlands as an undiminished capital from which timber

adequate to fill all demands is drawn off as interest. In 1902 the state forest of Saxony, comprising 432,300 acres, yielded an interest of 97,200,000 feet, thus providing an annual net revenue of $4.50 per acre. In the same year the entire German Empire made a total profit of $23,000,000 on its state forests.

These days, in the human world, we hear a great deal about the frills and fancies of education. There are corresponding collegiate luxuries in the tree kingdom. Man is the instigator and he maintains fashionable finishing schools where he trains trees in odd and sometimes grotesque ways merely to satisfy his own whims and oddities. Up until the middle of the last century "verdant sculpture" or "topiary work" was a leading attraction of the great private estates of England and the Continent. Under the expert hands of skilled gardeners, trees were clipped and trained into all kinds of strange shapes. Sometimes they merely represented geometrical designs. More often they were cut to represent birds, beasts, and even human forms. They were usually more novel than beautiful and required constant and infinite care to keep them in proper condition. Pliny is mentioned as having his Tuscan villa decorated with rows of verdant sentries. Before 1700 the Italian gardens were

full of examples of this art. The French Louis XIV had some grounds of this kind at Versailles. There are a number of present day hereditary estates in England where the art is still practised. The yew is always a favourite of the tree sculptors.

America is now fast following in England's footsteps in the matter of beautiful modern estates. One has only to glance at a list of hundreds of country places owned by multi-millionaires to see that America will soon lead in the number and variety of her beautiful sylvan retreats. These are usually characterised by spacious grounds and effective landscape results, with garden fronts of genuine grandeur. Perhaps among the best examples of beautiful American landscape work are the estates of Samuel Untermeyer at Greystone-on-the-Hudson, and the summer home of Murry Guggenheim at Hollywood, New Jersey.

What is called espalier work is another tree-frill which man is responsible for. The Italians, Swiss, French and Germans are especially adept in this new art which trains fruit trees to grow into all sorts of ornamental shapes. A favourite method is to grow a tree up against a wall or a lattice-work and to bind the branches so that they climb up in long, straight vines. In this way one makes climbing plants of apple trees, bushes of peach trees and

woody snakes of almost any tree. The owner of such a garden can pick his breakfast fruit from his window. If the weather is a little cold, or insects especially hungry, he often places paper bags around the ripening apples or pears.

To the Japanese is granted the ability to make playthings of the trees. By a special course of repressive training they are able to dwarf the processes of nature so that a pine springing from ordinary stock grows to a maturity perfect in every way and dies at a ripe old age of one hundred and fifty years without exceeding a height of one foot and without ever getting its roots out of a flower pot. It is positively uncanny to see one of their gnarled but miniature maples and realise that this is no product of the toymaker's art but a living, growing thing reduced by man's genius to about one-sixtieth of its normal size. It is not uncommon to see a whole landscape reproduced on a tray.

Such phenomena are only developed through unceasing care and patience. The general mode of procedure is to plant an ordinary tree-seed in a small pot. Just as soon as it raises an expectant shoot above the ground some vigilant man by never-ending pruning and nipping prevents it from expanding its branches beyond a definitely proscribed

limit. The little tree is lifted out of its soil every few days to have the roots which are attempting to burst its pot-prison trimmed. When winter comes it is buried alive under ground so that it may not freeze. In the spring its bursting energies are trimmed afresh, it is replanted and carefully nurtured. This process goes on until its growing tendencies are permanently curbed and it settles down to a life of Lilliputian prosperity. No matter how small they may be, these little pines demand their full quota of air and sunshine, as many Americans who have attempted to keep imported specimens have learned to their sorrow. The Japanese perform these dwarfing miracles by no magic art or diabolical cunning, but merely through the exercise of great care and patience along lines which many years of experience point out. That foreigners can master the art is shown by the fact that at least one American naturalist at one time had a conservatory forest of larches, bamboos and maples ranging from six inches to two feet tall and all grown by himself.

Perhaps the greatest tree college of the country is the Arnold Arboretum of Harvard University. In this great outdoor museum of living things, practically every tree which can exist in the Massachusetts climate is grown, studied and card-in-

dexed. They are arranged in botanical sequence but without the formality of a nursery and with a decided eye to scenic effects. The Arboretum is undoubtedly the leading experiment station of the continent, and a place where many foreign trees have been adapted to American ways, or have received American educations. Under the able direction of Professor Charles S. Sargent, the Arboretum workers have scoured the world for specimens of unusual interest. Professor Sargent by wide travels has become an eminent authority on the trees of North America. By a special arrangement, the Arboretum has been incorporated into the park system of Boston.

The career of each tree-student is most interesting. Like its Japanese dwarf relations, it is planted in a tiny pot, but only until it has passed the delicate days of early infancy. As soon as it begins to fill its initial quarters it is removed to a larger pot or sometimes grafted onto some hardier specimen of the same kind. After passing a winter in a "cold pit" it is set out in the kindergarten grounds, where it is nursed through a happy youth, and sheltered from all climatic vicissitudes until it reaches sapling independence. At that point, it is transplanted with many of its kind to a group destined to be thinned down until eight or ten remain to per-

petuate the species. The typical and most perfect of the group stands a little apart from its fellows, like an honour student in a college, as an example to the others and also that it may have a chance to develop to the fullest extent. Every specimen is numbered, labelled, placed on the map of the grounds and given space in the detailed records quite as thoroughly as the students of a man-college.

With such careful training and with so many tree histories to study, it is only natural that the Arnold Arboretum should furnish much valuable data and be a most worthy exponent of tree-education in general. Each year registration in this tree school shows a healthy increase and a more varied list of localities from which the students come.

VI

TREES THAT KEEP A DIARY

"Tongues in trees, sermons in stones,
Books in running brooks, and good in everything."

TREES not only keep a diary but give the greater part of their lives to building the house in which it is stored. After all, what is a tree but a vast record of achievement where every incident and vicissitude of its life is set down with infinite precision? We ordinarily think of a tree as a homogeneous living unit, yet science tells us that only the leaves and a narrow sheath of the wood composing the trunk and roots are actually alive. The rest of its great bulk is made up of layer upon layer of the dead and solidified bodies of innumerable cell generations which form a permanent and most interesting record of the tree's history. Not only the annual ring growth but the bark, the branches, the leaves and the roots all bear accurate witness to the passage of time and make up one of the most complete autobiographies possible.

All of us have learned to read some of the large outstanding facts which every tree bears on its

face. We see a sturdy old pine standing aloof on a hillock. We note its broken and stunted head. We see that the branches on the side of the prevailing winter winds are short and stubby, while to leeward the limbs are graceful and well-filled. The massive and time-scarred trunk, like an aged man who has known many rebuffs in life, has been a little inclined by many gales. Everything about the tree tells of a grim and courageous stand before almost overwhelming odds.

Down in Texas, in the centre of one of the widest parts of the Trinity River, stands an immense sycamore tree. Its bare and leafless arms raise brave but decrepit tops above the flowing stream. There are no less than seventeen openings in the huge trunk through which bees pass in and out. No doubt it is honeycombed throughout. One can see that this tree is not only very old but that it must have got its start before the river flowed into its present bed. Inquiry among the people of the neighbourhood will reveal the fact that the exact date of this event makes the sycamore an advanced centenarian.

The very shape of a tree is a rather complete index to the events of its life. A person well acquainted with tree habits can point out how a particular tree reached yearningly toward the light

THE HICKORY OFTEN BRANCHES IN A WILD, IRREGULAR WAY

THIS WESTERN JUNIPER HAS HAD A QUIET, PLACID LIFE

here, overcame some heavy obstacle there, was injured and even thrown to the ground by lightning at another point, rose with dogged determination and was finally aided in its renewed struggle by the additional air and light afforded through the death of a neighbour. So far-reaching are these external indications of tree-history that it would seem as if we could sometimes read a sylvan love-story and see a male tree (that is, one bearing male or pollen-producing flowers) incline toward a female, or some forest patriarch stand mourning over his dead wife.

Even scientists admit that trees have their laws of marriage and courtship. The Indian fig tree is such an ardent lover that he will actually take on the form of a vine if his mate chances to grow a distance from him, and by this means reach out his arms that he may embrace her and powder her face with his perfumed pollen. It it not uncommon in a great forest to see trees affectionately embracing each other. Not a few trees have become extinct as a result of intermarriage with foreign trees, or different species. In some cases a healthy hybrid is produced, but more often there are no offspring.

Bark tells much; in fact, it may be said to represent the private note book of the trees—a place where all secrets are written. The outer covering

of a youngster is green and sappy. Old trees accumulate a thick layer of dead, corky cells which present a shaggy, venerable appearance compatible with dignified age, and not unlike in appearance the wrinkles on the face of an aged warrior. The sassafras tree takes on a rough bark in two or three seasons; in other words, it ages fast; but most trees are glad to retain the smoothness of youth for at least ten or twelve years. Like human beings, those trees which are well protected retain their youth much longer than those which have many hardships and struggles. The beech presents an unruffled almost papery surface—or skin—all through life. It is therefore very susceptible to injury. Each variety of tree soon develops a definite, easily recognisable bark pattern, which serves as an admirable means of identification.

Besides growing concentrically in wood and bark a tree grows linearly at each twig. Each season sees on each small branch the repetition of the first-year process which developed the infant tree from a single leaf into an herbaceous shoot. The end of each branch grows out a certain length and then provides itself with a terminal bud. The number of bud rings on a branch indicates its age, while the distance between them shows how much it grew each year. Each falling leaf makes its scar and the

scars thus give a complete record of the total amount of foliage. On trees like the beech, flower scars are also discernible. In this way each branch bears a complete and extremely accurate record of its life on its face. With only a little practice it is possible to mark and diagram the life history of a young tree-shoot with the utmost precision. You can point out how old it is, just how much it grew in all its parts each year, and the exact number of leaves it put forth each season—in other words, you can take its exact physical measurements and test its life strength as a physical instructor would do. The lack of small side branches on a tree bespeaks advanced age. The older a tree gets, the more sap it requires for the main stem. The lower small branches are gradually dropped off as they are no longer needed and are an unnecessary drain on the tree's resources.

Each tree diary is different, as the diary of two human beings would be different. When we cut into or dissect a tree we get at its intimate daily life-story. According to Professor Ferdinand Cohn, some plant cells "are round or oval, or resemble a many-sided crystal. Some cells become flat and square, like a tile; some put out rays, like a star, or form a zigzag, like the wall of a fortress; many lengthen themselves out. The inner structure of

the cell also changes with age; the envelope, delicate and thin in youth, afterward receives accretions and ornaments. Some cells have within a hollow screw-way, like a winding stair; in others, the inside is covered with beautiful nettings, rings, flutings, or lattices. Most cells thicken their casings, as the oyster does, by adding new layers over the older ones; and, when their hollows are quite filled up, they may rival stones and bones in hardness, as, for example, the cells of the ironwood and the ivory-nut.

"As the cell-wall grows thicker, fluids and gases penetrate its invisible pores with more difficulty; and with continuous increase of thickness the living protoplasmic bodies inhabiting its interior must finally die for want of food. They in effect build their own coffin, immure themselves living in their own cell-prison. But a wonderful provision prevents the food being entirely cut off. While the cell-wall is arching itself up more closely and thickly a few doors and windows are still left open in it, through which communication may still take place with the adjoining cells; this occurs by the cell-wall not becoming strengthened at particular points; and when, in the course of time, the shell has become still thicker these places appear as pores or canals which lead outwardly from the interior of

the cell. And it is worthy of remark that at each point where such a canal penetrates the thickened cell-wall a corresponding passage is also left open in the next cell, so that the two canals meet each other, and are only separated by a thin partition. Communication continues uninterrupted by these pore canals."

Thus we see that each separate plant according to its own peculiar disposition records in its cells its likes and dislikes, its ideas of art, of defence, unity, and all things that go for its betterment and future good; in other words, it not only gives us its minutest history but also a prophecy of its future development.

It is quite a mistake to say that a tree grows up. What it really does is to add to its girth each year and grow linearly at the ends of its branches. This can be demonstrated by cutting some mark (a love-token will do) in the bark of a young sapling and observing that through the years this always remains the same height above the ground.

In all countries which have a cold winter the annual ring-growth of wood in a tree's trunk is an accurate indication of its age. This concentric diary is sometimes illegible but always authentic. In the tropics, where cold weather does not stop tree-growth regularly each year as it does in the

North, there are a number of rings for each year. Even in the cold countries a season of drought or some other climatic disturbance may produce sub-rings so prominent as to obscure the annual ones. Nevertheless, they are always there and can be made to tell a tree's age within a very few years. Even female trees have not yet found it necessary to resort to cosmetics and face preparations, as some human beings have done, to conceal their correct ages. A tree does not mind the world knowing that it is three thousand years old.

It is unfortunate that in a great many very old trees the earliest pages of our diary have not only become yellow with age but crumbled away entirely. Thus when in 1812 an ancient oak was cut down at Bordza, Samogitia (Russian Poland), there were counted 710 rings toward the centre on a transverse section and then the record became entirely illegible. The missing portion was estimated to cover about 300 years. The age of living trees may be estimated by making a lateral incision somewhere in the trunk, counting the number of rings per inch, and, comparing these figures with the diameter, thus computing the total number of annual growths.

This diary of concentric rings tells much more than the mere age of a tree. Every important change of weather, every minor incident in the

tree's life is shown there with unfailing exactness. Let the tree encounter some rock or other obstruction and its pages at that point will be crowded and cramped for many years. Upon the removal of some overgrown and close-pressing neighbour, the diary-keeper will write in a much freer and larger hand. Upon reaching maturity the strain and attention given to raising the first family will be reflected in shorter and less complete entries. The pages which by their position are turned toward the sun inspire larger letters than the cramped script turned out in the semi-darkness of the sunless side. A thousand moods and factors enter into the composition of this wonderful manuscript. And who can assure us that a part of the music of the violin has not been recorded in the wood?

A man wanting to do a bit of research work of the most fascinating kind should go into a lumbering region and make a careful study of some prostrate monarch of the first-growth era. He may not be able to read the open diary displayed before him as thoroughly as a trained naturalist, but many outstanding features will be quite apparent and will well repay the trouble necessary to decipher them.

Let us imagine that we, as a party of nature-lovers, are standing around some great and vener-

able log. Some of us are naturalists, some of us are woodsmen, some of us are merely keen observers. By our own united efforts we hack out the big tree's closest secrets and translate the sensations and emotions of over a thousand years into actual words. What tragedies are revealed! Perhaps an early love affair caused the tree to vainly reach out its youthful arms toward some heartless flirt, and this great secret is only revealed after many years.

"The hand of man has indeed laid me low, but I am proud that it took all his skill and ingenuity to succeed where centuries of storm and winter-ragings failed!" boasts the tree.

"You all have agreed that I am a white pine. To save you the measuring, I might tell you that I am 150 feet tall, 8 feet in diameter at the base and weigh an unbelievable number of tons. I am a little time-worn but proud of my scars as a true soldier should be. I have had the misfortune to be struck by lightning more times than I can remember, and I have suffered all the other hardships common to the tree kingdom. Yet for all this I have uncomplainingly held my own with the world, and it took a man-made axe to bring me down. I am proud that calamity overtook me standing!"

A subdued titter runs round the circle at this

startling evidence of sylvan egotism. The tree does not seem to notice it but goes right on.

"Mother Nature matures a million conifer seeds for each one she chooses for growth. For that reason it is hard to say just where I came from. The cone which contained my seed may have been trampled into the earth by some passing bear, or it may have been buried by some wandering squirrel. Yet, as my family are a very proud and aristocratic race, magnificently educated and accustomed to rare care in sending their seed-babies forth into the world, it is most probable that I floated from the cradle (seed-cone) which was carefully held in the affectionate arms of my dear mother, and was landed in a safe place in the big world. You know that pine-tree mothers never send their babies into the world in a haphazard way, but always have them attached to a parachute when the pine cone bursts open. The first thing I remember is when I thrust my tiny, adventuresome head above the surface of the ground. Of course I had already slept some time under the warm soil in order to spring up; then it was that my diary of concentric rings began, and every event of my life is recorded in characters of unmistakable clearness.

"A careful inspection of my diary shows 1025 pages; I am therefore 1025 years old and was born

in the year of 891. This was at the time Alfred the Great was slowly welding the rough Anglo-Saxons into the first beginnings of the England of to-day. It was not until 600 years later that the first European was destined to set foot on these American shores. From the American standpoint this makes me a prehistoric tree. I am more American than the Indians themselves, and I regard them somewhat in the same light that you regard the immigrants that land here to-day.

"By a careful counting you can easily fix a number of important facts in my life. When I was a vigorous but willowy sapling of twenty-five some heavy object, probably a dead neighbour, fell upon me and almost gave me curvature of the spine. After some five years of struggling I succeeded in throwing off the encumbrance and gradually resumed my natural and upright position. For almost a century after that I went through a period of even, rapid growth while I climbed my way into the upper air and light. My rings grew symmetrically on all sides with the pith in the centre, indicating that there were no crowding neighbours to hamper my development. Exceptionally thick rings tell of moist, sunny seasons. Occasional thin ones indicate severe droughts or cold spells.

"About 1056 a great accident occurred. My

great-great-grandmother, a tree-woman of tremendous proportions, fell on me and besides breaking off two of my choicest branches, drove her sharp pointed hands into my side. They left me a temporary nervous wreck with a great ragged scar which healed over the two bits of wood your axe just uncovered a moment ago.

"I am afraid the recuperative powers of a tree are not always as great as they might be. Like human beings, the more cultured we become, the more are we subject to ills and consequent slowness of recovery. It took 300 years of ring-growth to completely heal this wound and in the meantime I had to fight off invasions of ants and various kinds of borers who, entering through the opening, many times established colonies in my vitals. Had it not been for the wonderfully healing qualities of the turpentine and rosin in my blood, which flowed freely over the wound, and for the chickadees and wood-peckers, which aided in clearing out these pestiferous insects, I should not be here today. Just notice the little rows of incisions the birds made in my bark. They are my best friends. I love to have them near me.

"In 1256 lightning or some great storm tore off one of my highest limbs and shortened a shoulder. A great bear used to sit upon that crooked

limb and dig honey out of the hollow you see in the big broken branch. In the year 1345 both my neighbours and I suffered from climatic disturbances, and in 1381 I was bombarded by an avalanche of rocks—so severely that one of my upper branches was broken off and, as you will see, fell to the ground and became petrified. Two of the rocks remained embedded in my body. The splintered wood of 1394 would indicate an earthquake, or possibly an exceptionally heavy lightning jolt. Along about 1400 evidences of man begin to appear. The years 1485 and 1486 each have flint arrow-head markings in their diary pages. What a story they could tell on their own account! 1636 (the 745th year of my life) shows axe and fire markings. There is some indication that in 1878 my body acted as a target for some stray bullets. But of all trying years 1809 was my hardest. There were troubles in swarms; my ring-diary is a mere thread of wood at that point. I was too disturbed to record all that happened. In 1885 one of my main side shoots went down before an accumulated weight of ice and snow. You can see the shattered and pitiful stump it left . . ."

Thus the fallen monarch rambles on, like an aged veteran, and has something to say as long as one cares to examine fresh cross-sections. Historians

should realise that the trees contain the most authentic records in existence.

It is to fossil tree diaries contained in geologic and coal strata of the earth that we turn for practically all our information about the carboniferous and coal measure world periods. Tree trunks, often having roots and branches attached, tell us intimately of the long distant ages in which they flourished. Cones and leaves indicate their formation in great detail. The coal-forming ages were those of great ferns and conifers. The calamites were sort of immense asparaguses and related to our modern ferns known as horse-tails (*equisetum*). They grew by underground stems which sent up shoots into the upper world at intervals. The humble three-foot lycopodes of our day, whose chief means of protection against grazing animals are their ability to poison their destroyers, were 80-foot trees then. The segillarias rose to a height of 100 feet. Queer spotted and corrugated trunks lifted their thick heads everywhere out of the marshy and fog-covered land. Flowers were hardly in existence. It is estimated that it required the passage of 122,500 years to accumulate sixty feet of coal. We are indeed fortunate in having numerous tree diaries to help us mentally reconstruct the mighty age in which they lived.

VII

TREES AND THEIR BUSINESS METHODS

IN the tree world, as in the human, business success depends upon such factors as heredity, environment, education, ambition and working methods. Some trees like the scrub oak seem satisfied with eking out a bare existence on some lone hillside. Others, like the giant redwoods, grow to magnificent proportions and become the millionaire capitalists of the forest. Behind each is a story of influences and selective development stretching back to the creation. Each tree and many human beings are largely the product of forces over which they have no control.

In the case of a tree, there are a thousand impresses bearing on its life. To begin with, mysteriously wrapped up in the seed or nut is a facsimile of its immediate forbears with minor deviations harking back to remote ancestors. As soon as the seedling emerges from its temporary prison it sets out to realise its predetermined structure. If it were growing under a glass dome with an

expert gardener to keep its supply of air, water, sun and soil nutriment just right, it might succeed. As it is growing out in the busy element-racked world, it is forced to make slight changes in its plans before it is a year old. The first thing it may notice is that there is too much moisture in the air to suit its particular style of beauty. Just when it is getting adjusted to that, a drought comes along and conspires with an unusually hot sun to burn it off the face of the earth. Weakly escaping, it is all but uprooted by a hurricane and given a permanent tilt to leeward. In its fifth year some ungainly animal attempts to tread it under foot and only succeeds in giving an ugly and life-long droop to one of its most promising branches. So it goes all through the years. Our brave sapling spends most of its thought and energies in adapting itself to new and trying conditions. It is in the grip of the famous "survival of the fittest" régime. As it succeeds in surviving, we admire or pity it.

The vicissitudes of a forest tree and those of a man-tended garden tree are quite different, with a corresponding divergence in their business methods. In a dense wood there is what one might call a free-for-all fight for air, water and earth continually in progress. Weak brethren are crowded not to the wall but up against the dense,

sun-obscuring foliage of close-standing neighbours. The motto is: be a quick-growing giant and force yourself up into the luxury of upper air and light or lie down and die. So the members of a pine forest hold their arms close to their sides and poke long slender necks up toward the source of all light and power. On the other hand, if given the space and light of some open spot, they put out generous lower branches much like other tree folks.

The hard conditions of sylvan life develop strong hardy types of trees, but many individuals are lost in the shuffle. Civilised trees, like civilised men at their best, show the highest, all-round development. Given ideal location, food, protection and attention, with even heredity helped along by seed selection, the trees of our parks and meadows undoubtedly become the strong men and beauties of their race. Yet there is every indication that they pay the price by a loss of resistance to the dangers and trials of their old life. This is particularly true of fruit trees, which are the "softest" and most educated of their kind. Neglected apple trees seem to degenerate. They become knotted and gnarled. Their fruit gets small and bitter. The trees of abandoned orange groves revert to savagery at once, arming themselves with immense thorns.

Some wild trees, like many wild animals, do not thrive in captivity. Spruces, particularly, seem unable to adjust their business methods to fit the conditions of man-raked lawns. Individuals which will thrive in the rocky fissures of some desolate glen will droop and die in a well-kept backyard.

The annual temperature and the annual rainfall are the primary things which affect tree growth and therefore sylvan business methods. Other influences which the trees have to take into consideration are humidity of air, wind exposure, slope exposure, degree of slope, and soil depth. Many trees overcome variations in moisture by sending roots far down into the sub-soil. This makes them unaffected by ordinary droughts provided the year's precipitation is normal. The yellow pine flourishes equally well on the slopes of the Sierra Mountains, where most of the rainfall occurs in winter, and on the Colorado Plateau of Arizona, where summer is the wet season.

Most trees adjust themselves to winds of all velocities. With extra root braces they face the most trying storms. The altitude line of the yellow pine is much the same all over the United States, indicating that places of exceptional exposure do not become untenable to the trees.

When the wind or the cold becomes very severe

on the mountains, the trees grow small and compact hugging the ground almost like bushes. This tends to make them crooked and deformed and a little unlovely, but they have an important place in the economy of the woods. The scrubby-looking trees far up on the timber line help to bind down the earth and shade the moss of those altitudes. The earth and the moss soak up the rain as its falls and thus prevent the water from tearing madly down the slope in a devastating flood to be later succeeded by a more injurious drought. The aristocratic trees of the valley owe their lives and prosperity to their stunted brethren high above them.

The life of the ordinary tree of the forest is marked by a continual use of shrewd and ingenious business methods. Every one knows how the trees protect themselves from the winter cold by an extra coat of bark and moss on the side of the prevailing winds (usually the north). Conversely, the longest and largest limbs are most often to be found on the southern exposure, away from the dangers of the icy blast.

The trees are the best mechanical engineers in the world. Each individual is built so that the various loads and stresses of its body are taken care of to best advantage. The main stems of tapering trees, like the California pines, in structural de-

sign are much like the Eiffel Tower or certain types of bridge piers. The ordinary tree has a much finer problem of balance and adjustment on its hands. Exposed specimens have powerful reinforcement in the shape of large wind-struts near the base which extend to anchoring roots much like the flying buttresses of Gothic architecture. Living cells are the trees' building material. Those near the base must have a compressive strength equal to the entire weight above. Those in a limb must have strength to resist the bending power of gravity.

Trees in the forest are always very quick to take advantage of every scrap of air and sunlight to be had. When a citizen of a tree city falls, his surrounding neighbours at once send out branches to fill the space which he leaves vacant. The pines have a habit of dropping needles around their bases until they have built miniature hills on which they stand. These mounds serve a very useful purpose in draining the water away from their trunks. The pines are exclusive almost to the point of snobbery. They often mat over large areas in their vicinity with their needles to such a depth that nothing else can grow there.

The manifold shapes and forms of the different tree leaves often have a utilitarian basis. The im-

mense, umbrella-like appendages of the palm serve to drain and shade the tree. The five-pointed leaves of the sweet gum prove quick absorbers of sunlight. Trees of the far north, like the scrub willow, often have tiny leaves which point down and dispose of any ice or snow which comes their way.

The "sneeze wood" tree of South Africa has a unique way of protecting itself against enemies. Its wood is light brown in colour, runs very close-grained, is so hard as to sink in water, is bitter to the taste and emits a microscopic dust on being sawed or cut. No insect or worm will touch it and men who handle it are continually sneezing.

Sometimes the trees form business alliances with other dwellers in the forest. Such species as the pines not only provide shelter for birds and small animals but furnish the straw to line their nests. A hollow tree will serve as a home for hundreds of wasps, bees or ants. All such creatures will naturally take a proprietary interest in their dwelling place and ward off the attacks of anything which would injure it. Even frogs and snakes are sometimes allies of the trees.

There was once an elm which was terribly burnt and scorched by a nearby house which got on fire. All the bark and limbs on the exposed side became black and lifeless. Every one thought the tree

would surely die, but did not take into account an inherited pluck. Though worse than a cripple, it valiantly put out new shoots from the uninjured side and soon had increased its leaf area sufficiently to give it a new and promising start in life.

This incident illustrates the marvellous capacity for adaptability possessed by many trees. The obstacles they sometimes surmount are truly surprising.

People tell the story of a certain silver maple which was split in two by a lightning stroke. One of the halves was left standing, horribly bruised and maimed. In a few months the exposed wound began to decay hopelessly. Forthwith the tree sent out adventitious roots from the surrounding bark to bolster its waning strength by sapping nourishment from its own decaying heartwood. Instead of asking for a transfusion of blood, this plucky maple sucked its own.

Another maple through some accident lost all its bark and the all-important cambium layer from a short section of its trunk just above the ground. This had the effect of cutting off the upper leaves and branches from the nourishment-giving roots. Quick death would have been the inevitable result had not the resourceful creature at once put out an aerial root from a point just above the wound.

This root, after traversing the exposed heartwood, entered the ground, and at once set about supplying food for the whole tree. The task proved so Herculean that the maple finally gave up and withered away to an honourable death.

Occasionally one sees a tree with a divided base, a case where two trunks merge into one a few feet above the ground. A likely explanation for this peculiar arrangement is this: a wind-carried seed is deposited on the top of a decapitated stump. The sprouting seedling gets some nourishment from the decayed wood of its natal perch, but soon decides that if it is ever to get ahead in the world it must reach the solid earth. Forthwith it sends down two slender roots, one on each side of the stump. These serve their purpose admirably and, as they grow, assume the look and function of twin trunks. In time the old stump rots away and the tree which once sat on its back is left high and dry on a pair of stilts. The birch is a tree very likely to do this sort of thing.

There is on record the case of a catalpa tree which through great age had become a mere shell. In fear of a general collapse, somebody took down the tree's whole top, leaving the hollow trunk standing bolt upright like some great natural chimney. Into this huge flue an ailanthus seed blew one day

Photo by S. N. Bunnell, Pasadena, Cal.

A GOOSEQUILL REDWOOD REARING ITS YOUNG WITHIN ITS OWN BODY

A GROUP OF SOUTHERN PINES WHICH HAVE SENT LONG TRUNKS UPWARD TO SEARCH FOR LIGHT AND AIR

and soon had grown into a lusty little sapling completely within the body of its host. The catalpa seemed to receive revived hope from this exhibition and put out some vigorous new lateral shoots from its hollow walls. Here was an example of one tree growing within the other.

A case of the same kind is shown in one of our illustrations. This young sequoia of the goosequill redwood variety is sheltered within the hollow trunk of its parent. It will undoubtedly have a successful and rapid growth.

Every thrifty tree stores quantities of nourishing starch and gum in its wood for just such emergencies. There come times when it is necessary to put out buds from the main stem instead of the remote branches. The starch and gum is what they live on. Occasionally one sees a floating log or a fence post or even a rustic bench sprouting in one last desperate effort to retain a hold on life.

When one sees two tree trunks twisted or curved about each other, it is not always a case of brotherly love. It is more likely a case of accidental proximity with a corresponding struggle for supremacy.

Two hemlocks once grew together on a certain waterside rock until they became too big for their combined foothold. The larger tree nearer the land opened hostilities by spreading its boughs

wider and wider as if to push the other into the water. The second hemlock felt the strain, but instead of submitting, produced a huge root which coiled around the aggressor's trunk in a strangle hold which said: "If I fall, you go with me."

In such ways do the trees adapt their business methods to strange and extraordinary conditions. In many cases they are more sagacious than men.

VIII

TREES THAT MANUFACTURE

The poplar there
Shoots up its spire, and shakes its leaves i' the sun.
—CORNWALL.

AMONG the many and diverse products manufactured by the trees are oils, perfumes, gums, syrups, gases, fibres, laces, threads, dyes, drugs, chemicals, food material, beverages, tar, pitch, turpentine, rosin, paint, chewing gum, rubber, cork, water, milk, honey, intoxicating liquors—and this is only a partial and very fragmentary enumeration. All of these are things which are economically important to man. Other articles which trees produce more for their own welfare may be listed as needles, pins, razors, daggers, swords, spears, plates, cups, saucers, knives, forks, caves, cisterns, faucets, hats, dresses, coats, airships, balloons, boats, submarines, munitions, musical instruments, tombstones, coffins, ropes, swings, hammocks, umbrellas, pumps, bird houses, bee hives, cages, beds, necklaces and beads.

Trees do more than manufacture. Many of them have reached the factory stage of production, and by large scale and mandatory monopolies of raw materials not only force competitors to the wall but deny them space in which to eke out an existence. Few plants or trees are hardy enough to establish themselves in a pine tree city. The autocratic conifers have such a trust-like grip on air, soil and water that an intruder can do little more than shrivel up and die. Some trees, like those of the great tropical forests, seem to enjoy having all kinds and sorts of small plants thrive at their feet. But this is not true of the pines; it is only when they have exhausted all the food material of a place and themselves fall before the Sherman Anti-trust Law of time that the small competitors have a chance.

Not a tree exists that is not engaged in some kind of manufacture. They are by nature manufacturers, and their very life processes are those of their chosen profession. Man subsists largely on elements which other plants and animals have already arranged in organic form. It is the tree's problem to take carbon dioxide from the air and water and minerals from the earth and from these simple things manufacture living and complex tissue. Nothing is more wonderful and mystical than

the plant process of photosynthesis by which the tree-leaves, breathing in atmospheric carbon dioxide, combine it with certain soil elements to form starch, which, being transformed into sugar, is conveyed as sap to all parts of the organism.

To describe in detail just how the various tree-products are manufactured would make a book in itself. We shall have to content ourselves with considering only a few. Among the many oils cocoanut-oil, castor-oil and camphor-oil are good examples. The lilac, apple, peach, rose, cherry, orange or almost any flowering tree manufactures perfume. In cases like the magnolia the flowers are so highly perfumed as to be almost nauseating. The perfume is not always found in the flowers; sometimes, as in the sandal wood and sassafras, the wood itself is perfumed. These woods are frequently burned for their perfume.

There are numerous trees which manufacture gum; the gum-amber and the chicle are the best examples. Even such common trees as the cherry and the plum exude a vegetable mucilage which might be classified as gum. The gum of commerce comes from Africa and Arabia. The trees which manufacture it are the sahel, fatack and hiebar. The first produces a white gum held in much esteem and called vereck; the other two turn out the red

nebuel of the trade world. In Sicily the natives find a sugary gum exuding from the flowering ash tree; they gather it with a knife in the same way that children gather chewing-gum from the spruce tree. There are similar exudations in the larch tree. Some of these gums, especially the sugary ones, are fairly nutritive. It is said that members of lost caravans have more than once been saved from starvation by eating gum contained in their cargoes.

Syrups, which are really thinner gums, are exemplified by the common maple syrup, and also by the sap of such smaller plants as the cane and the corn. These, in various degrees of density and in unlimited flavours, form valuable foods for humanity as well as numerous plants and animals. Trees always manufacture the exact things they need; man should remember that he is only one of nature's wonders!

All trees exhale oxygen or other gases; in the tropics there is a gas tree with exquisite white flowers, and tapering, candle-like branches. The exudation of gas takes place in the form of vapour. Another very interesting gas plant, the fraxinella, exudes such quantities of gas that if it be protected from the wind by means of a paper or sheets of glass and a match applied, it immediately takes

fire and gives out an exquisite bright, sparkling light, like that of the effective lycopodium in the old time melodrama.

The tropical lace-tree weaves patterns which are the envy and despair of all needle workers and are reminiscent of the wonderful needlecraft of the submerged water plants with their laces, frills, and ribbons! Many trees manufacture fibres and threads. Bark often takes the form of beautiful mosaics. In all trees bark grows on the inside; that is, the active cambium layer keeps adding annual growths on the inner side of the accumulations of the past years. The same layer of bark which enclosed the sapling stem of two summers girdles the trunk of the young hopeful of twenty. To take care of the trunk-growth of the tree this initial bark ordinarily stretches and finally cracks open and shows the furrowed surface with which we are all familiar. In the lace-tree, by some caprice of nature, it does not crack open, but continues to stretch until it shows every vein and cell-grouping in a marvellous vegetable lace-tracery, like man-made lace stretched over a frame.

Trees are the great sources of the natural mordant vegetable dyes, which are not complete dyes in themselves but are usually weak acids which, combining with certain metallic oxides, form fast

and brilliant colours. Thus one of our most important black and dark blue cloth dyes has its base in logwood, which is the heartwood of the *Hæmatoxylon campechianum* of Central America. Peachwood, sapanwood, limawood (known as the soluble redwoods) and camwood, barwood and sanderwood (known as the insoluble redwoods), all of tropical origin, are likewise important among the vegetable dyes. Quercitron bark, which is the inner bark of the oak tree, in solution with aluminum or tin forms a bright yellow. Every one is familiar with the red oak dye.

Of tree-drugs there is no end. From earliest times man has resorted to the leaves, bark and roots of trees and plants when in need of medicine. The cinchona, from which quinine is taken, is invaluable. Quinine is the only known cure for those dreadful fevers which are produced by the abundant vegetation in the very place where the cinchona thrives. Scientists in the near future will doubtless discover excellent uses for all apparently noxious plants.

The chulmugra tree of India manufactures in its seeds an oil very beneficial in the treatment of skin diseases. The wonderful qualities of the *Lobelia syphilitica* need no comment. The root-bark of the rusot (*Berberis aristata*) furnishes a valuable medical extract. Several volumes might be written

THE BANANA TREE YIELDS A FRUIT WHICH IS BECOMING A NUTRITIOUS STAPLE ALL OVER THE WORLD

THE TROPICAL BAMBOO IS AN EXTREMELY USEFUL TREE TO MAN

on tree drugs and chemicals; there are few trees which do not supply us with some form of drug.

There is scarcely any need to mention trees which furnish us with food material. To list all the fruits alone would be a lengthy task. They constitute some of the most delicious foods known to man. Half the delight of a trip to the tropics lies in the sampling of many strange-looking but delicious fruits. As children some of us may have eaten the brightly coloured and spicy nasturtium flower, but we would be quite astonished, even to-day, if some one were to tell us that there was a country where flowers are a staple article of diet. Such is the case, however. The country is India, and the flower is a heavy, edible blossom borne by the Mahwa tree. The corollas of these flowers provide a much appreciated feast for animal and man at certain times of the year. The surplus is pressed into bales which look like great bundles of decayed raisins and is fed to pigs and cattle. A portion of the flowers is also distilled into a species of spirit which smells like whiskey.

What would man do to-day without tea, coffee, and cocoa? It ought to make us feel a little ashamed to think how dependent we have become on these stimulating tree-beverages. Yet we must deal with facts and not theories. Father, mother,

and the children must have their morning cup. Society must have its afternoon tea. It is not at all certain that the majority of mankind, living under unnatural conditions, does not really need some mild stimulant to work most efficiently.

Nature offers beverages of all kinds! A benighted traveller in the South American forests finds himself in a situation almost as hopeless as one lost in the deserts of Africa. There are no cool springs, nor rocks from which water flows; and where he does find water it is filled with decaying and obnoxious vegetation. Sometimes, however, he is fortunate enough to discover the purple sarracenia. This marvellous plant's circling leaves unite at their outer border and form a graceful and elegant drinking cup. This exquisite goblet is decorated with scarlet veins—and the art of Etruria or Sèvres never constructed one more elegant. It is filled with clean delicious water and the weary traveller may drink with entire safety. In India the natives are furnished with reservoirs, which they call monkey cups. These flowery vessels are provided with delicate lids, which the careful plant always closes at night. Some of these cups will hold two pints of water.

If man wishes milk while travelling in the forests of Caracas, South America, Mother Nature is

ready and willing to supply him. The cow-tree gives abundant quantities; it has not only the exact appearance but all the qualities of cow's milk.

Certain trees act as churns. The natives of the Niger gather immense quantities of butter from the butter-tree. It abounds in great quantities and is likely to become an article of commerce. In the olden days the slave-dealer dreaded it more than anything else. It tended to bring his country into touch with civilisation, and once the King of Dahomey ordered its extermination. It was annually burned by royal decree, but it annually sprang up again.

It must be confessed that nature also has her wine! The wine-palm of Western Africa yields a delicious sap which is mild when first drawn, but begins to ferment in a very few moments after it is exposed to the air. The teetotaler may inform us that even though Mother Nature produces wine, she does this in only one country while she produces water in all.

Pitch, tar, and turpentine are resinous products present in many varieties of trees but which in the United States are obtained commercially from the pine family and more particularly from the *Pinus palustris* of the Southern States. In Florida and Texas great gangs of men go out every year into

the big pine barrens in quest of turpentine. Sap flowing from incisions made in the tree-trunks is collected and upon distillation yields water, resin and turpentine. Formerly much cruelty and needless destruction was visited on the trees by hollowing out cups to catch the sap in the heart of the creatures themselves, but now the liquid is collected in earthenware vessels. It has been proved that this sensible method means saved trees, a lower fire risk and increased output of turpentine. Turpentine finds the greatest uses in paints, varnishes and medicines.

To obtain tar the bodies of trees are put through a process of destructive distillation either by burning in kilns or as a by-product in the production of wood-vinegar (pyroligneous acid) and wood alcohol (methyl). A further refining of tar yields pitch—a substance of dark colour and brilliant lustre.

All man's wonderful inventions are copied after Mother Nature's marvellous arts. This is especially true of household supplies. The grandeur of man's achievements pales before the grandeur of Nature. She has her bath every summer morning; her cisterns never fail; her pumps never get out of order. For several hours after sunrise her leaves are covered with dew; her flowers sparkle with a

delightful brilliancy. This brilliancy is often due to the cold having condensed the aqueous vapour in the atmosphere, but quite frequently it is produced by the exudation of water from leaf-pores. The trees are washing their faces.

Nor is Nature satisfied in giving us wonderful things to eat; she is also quite as much interested in toilet articles—thus we have combs, soap, and perfumes; and lights for use indoors. The Chinese long ago learned to use the seeds of the leguminosæ for soap. Many of the mendicant friars of the Middle Ages used the leaves of the soapwort for cleansing purposes. There are numerous other plants which are used for various cleansing and scouring purposes. The fibre of certain tropical gourds is used for wash-cloths. Certain of the horsetails are used for polishing metal.

Perhaps in the manufacture of perfumes Nature is most successful. Rosemary is so common to Spain that the mariner can smell it leagues out at sea. France produces the finest perfumes; immense gardens of flowers are cultivated exclusively for that purpose. Their sap is condensed and shipped to all parts of the civilised world. In one establishment at Cannes they use annually nearly 200,000 pounds avoirdupois of orange flowers, the same amount of rose flowers, 13,000 pounds of black

currant flowers, 50 pounds of jasmine flowers, many thousands of pounds of violets, 100 thousand pounds of tuberoses, and innumerable pounds of carnations, to say nothing of many smaller plants.

Nature's perfumes are for her own use, and they are many and varied. She uses with wonderful skill her combinations of colour and perfume to aid in attracting insects to her flowers. These insects are often the main distributors of pollen from flower to flower. They are usually rewarded with honey.

All trees are manufacturers of beauty and charm. An exquisite creature like the southern pomette bleue (*Cratægus brachyacantha*) may not have marked commercial value, but its symmetrical outline, white flowers and blue berries make it a joy forever.

The story of chewing-gum is a fascinating tale. Its botanical name is chicle, and it is made from the life-blood of the tropical tree *Achras sapota,* an inhabitant of northern South America, Central America and certain states of Mexico. The sapota is a versatile tree, for besides manufacturing three to five billion chews of gum each year for persons residing in all parts of the globe, it also produces

POMETTE BLEUE. *Cratægus brachyacantha.*
This tree is a manufacturer of beauty and charm for its less lovely neighbors.

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a juicy fruit known as the sapodilla pear and a straight, clear timber trunk.

Chicle-gathering natives swarm up the trees in sap-flowing time and, clinging to the straight trunks with their feet and with ropes encircling their waists, use both hands to hack great V-shaped cuts with their machetes. The sap flows down these furrows to little receptacles at the bottom of each. Collected in huge pots, it looks like milk at first, but soon turns yellow and thickens to the consistency of treacle. The last vestige of water is driven out by boiling and kneading and the dough-like mass is ready for export. At the northern factories the long-suffering jaw-actuator is further boiled and kneaded, whirled in a centrifugal receiver, "fussed up" with powdered sugar and flavouring matter, rolled into sheets, cut, dried, wrapped, advertised, and as a last benediction sent to the slot machines.

The sapota seems to be a full-blooded creature, as it stands moderate bleeding for twenty-five years or more. Eight pounds of chicle to a gallon of sap is a good average yield.

We could manage to get along some way without chewing-gum, but tropical rubber has become a vital and intimate part of temperate zone civilisation. If it is true that we never miss a thing

until it is taken away, the sudden disappearance of the tree-product caoutchouc from the face of the earth would work strange havoc. With a tire-less car the joys of automobiling would be flown forever. With an unrubberised raincoat and no feet protectors London would become uninhabitable. Without rubber insulation to work with, electrical engineering would be set back ten years. Sans rubber tubing and a hundred other contrivances, the medical profession would be at a complete standstill. What would childhood be minus rubber balls, rubber boots, and rubber balloons? What would manhood be like with wooden fountain pens, steel pencil erasers, and paper garters?

In a sense rubber or caoutchouc might be considered a by-product, as the various tropical trees from which it comes secrete it in the form of a milky liquid which seems to be non-vital in the life of the manufacturer. The physical structure of this juice is as much like milk as it looks. Minute globules of rubber constitute the cream. They rise to the top and can be skimmed off. The usual way is to boil the entire liquid down until it becomes solid enough to be shaped into cakes. Recently a centrifugal machine which in operation is much like a cream separator has been introduced into the rubber fields. Much has been written about

these rubber fields of Brazil and Bolivia and how man in his rapacity thoroughly exploits both the defenceless plant and his own weaker brother. The rubber-producing trees used to be cut down, but now considerations of economy have led to the use of a series of circular incisions and a small clay cup to catch the liquid which comes from each. A tree yields anywhere from three to sixteen pounds of caoutchouc annually. It is believed that the caoutchouc mistletoe of Venezuela may furnish a new source of rubber. The fruits of this plant contain the much-sought substance in solid masses.

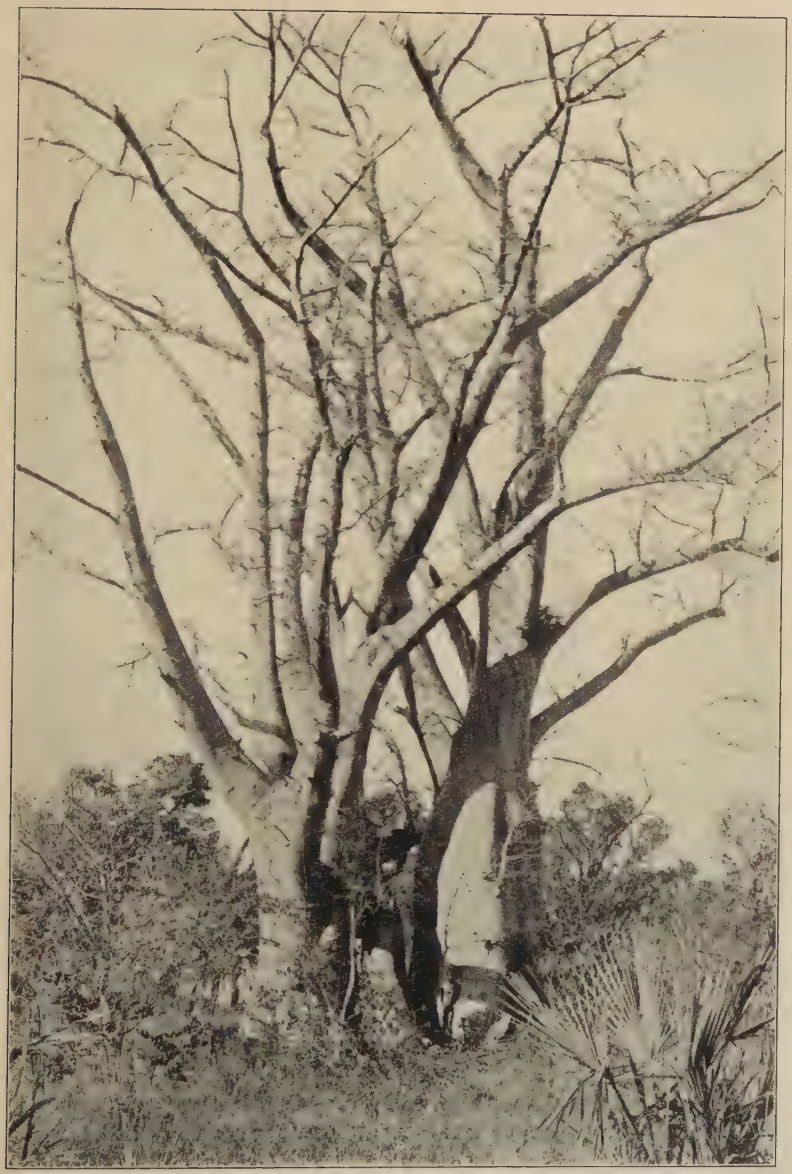
The bark of all trees contains cork. It is the growth of the cork which determines the pattern of the corrugated exterior. In the cork tree, cork cells are particularly and exclusively abundant, so that great layers sometimes as thick as twenty inches may be removed from time to time without endangering the tree's life.

One would hardly expect trees to engage in the liquor business, yet there is ample evidence that they do distil and brew on occasion. We have already mentioned the Mahwa tree blossom of India from which men make strong drink. There are trees which make their own "moonshine." So proper a tree as the common cherry has been known to allow its fruit to ferment so viciously that whole

troops of robins have been put, not under the table, but feet up in the grass through liberal partakings of the alluring fruit. The delicate bodies of birds are so susceptible to such excesses that certain neighbourhoods at times have been almost depopulated of feathery denizens who have imbibed too freely and were destroyed by cats. There are a number of small tropical trees, such as the wild mulberry, that distil on such a large scale that birds, frogs, and regiments of monkeys reel about on the hilarity of its freely-dispensed beverage. In fact, monkeys often fall into the hands of man because of their drink-befuddled condition.

Some men, in their conceit, really believe that all the products of nature, including trees, were created solely to satisfy human needs. Nothing could better prove the absurdity of this idea than the fact that there are many appendages manufactured by trees which are not only of no use to man but which are absolutely antagonistic to him. Sharp branches, and thorn-bristling twigs, like those of the hawthorn and the acacia, keep him at arm's length. The giant cactus is armed from top to bottom with swords and daggers; the razor tree of South America is covered with terrible razors.

Tree caves are plant creations which, with some justification, men can believe were created for their



A DOUBLED-TRUNK SPECIMEN OF THE USEFUL AMERICAN BAOBAB TREE

TAKING CIGAR-BOX CEDAR OUT OF A CUBAN JUNGLE

special benefit. Many a hopeless suitor or hard-pressed fugitive has delved into the bounteous shelter of some hollow oak just in the nick of time. Regicides and other types of patriotic criminals have lived for weeks within the bodies of trees. Think of all the gold, the town-charters, and the love-letters which have found the same resting place!

Trees are very faithful parents; they build various types of vehicles to send their offspring out into the stream of life. The bladdernut launches little seed boats on the neighbouring streams in order that its children may have a chance to make their own way in the world, and sometimes these tiny boats are so carefully sealed that they may be used as submarines and the tiny seed-passengers may dive beneath the waves in safety. The ash, elm, and maple have tiny wings by means of which their children ride the wind out into the big world where they may have a chance to properly grow and develop.

In the tropics is found a most unusual plant known as the cannon-ball tree. It drops its immense fruit with a hollow, reverberating thud which sounds like the falling of a cannon-ball. In the stillness of a jungle at night these reports sound

for all the world like the distant sound of heavy artillery.

Perhaps strangest and most dangerous of all the tree-manufacturers is the agy-tree. This uncanny inhabitant of the Island of Madagascar is the terror of the natives and missionaries who know of its miniature arrows. Mr. Montgomery in describing his experiences with it says: "Walking under some trees and pushing aside the reeds and grass, I was startled in a moment by a sudden tingling and pricking sensation over the back of my hands and fingers, for never had come the like to me, in Madagascar or elsewhere. I stopped in sudden surprise, for the pain was severe, and I had touched nothing except the grass. But in another moment the pain increased, the tingling burning sensation seemed extending rapidly up my wrists, and I could see nothing to cause it. But as I lowered my head to look, pain, scalding pain, shot into my ears and neck, growing worse, too, every instant. Dazed and bewildered, I stood a few seconds in helplessness, for I could neither see nor guess at the cause of the terrible distress. Then I got back to my company with agony writ plain enough on every line of my face.

"The men started up when they saw me, some of them crying out, 'You have been stung by the

agy!' Some of them led me to a seat, others rushed for water from the river, and two or three brought sand heaped up in their hands. . . . While the men were rubbing me I was able to discern to some extent the cause of my distress. Countless hairs, like tiny arrows, almost transparent, pointed at either end, and from a third to a fourth of an inch long, had dropped on me in an invisible shower from the agy-tree as I passed and stood under it. Ere I came away that afternoon, very cautiously I ventured to examine the tree at a little distance, and found that these tiny hairs grew outside a thickish pod or shell, not quite so large as a small banana."

One of the South American acacias manufactures electricity for its protection—or more properly speaking, it is an electrical dynamo. On touching it, one receives a shock so distinct that he is not desirous of coming nearer. Scientists are now working on the theory that certain electrically-charged trees exchange electrical or magnetic impulses through the air. And who can say that they have not a means of sending wireless messages? Surely such phenomena could be no more wonderful than the scientifically recognised work of telegraph plants and weather-prophet plants.

IX

TREES THAT TRAVEL

BEFORE the modern era of steam and electricity the history of man was largely a history of his migrations. When his house stood still, he stood still mentally and physically. When he moved about, his mind grew and his body changed its colour and its conformation.

The same is true of the trees. When they are content to stay quietly at home, they go on reproducing themselves in the same old way for endless generations. As soon as individuals or even extensive groups among them decide to travel a bit they undergo marvellous changes in the lands of their adoption. The tiny dogwood, scarcely six inches tall in Alaska, becomes a sixty-foot giant in Texas and Florida. In the far North the honey locust is little more than a shrub. On reaching the southern United States or Mexico it becomes a medium-sized tree, wonderfully defended by thorns and prickles. In the still more luxurious climate of South America it develops into an immense struc-

ture all bristly with vegetable spears and daggers and with a defensive army of ants. The trees are great believers in doing as the Romans do. In taking up new abodes they often make complete changes of clothing, habits, occupations and armaments. In general, they are more prolific in the South.

Moreover, travelling trees are not merely globe-trotters or vegetable hoboes. They travel by rule and method, and their knowledge of the sciences of chemistry and physics is astounding. They make geography every day. Like men, some trees follow rule and method more than others. Such trees as the pines, ashes, elms, cottonwoods and sycamores migrate in vast armies and, like the barbarian hordes of mediæval Europe, overrun the territories of neighbouring kingdoms, there to be swallowed up by strongly entrenched first-comers, or themselves to eventually supplant the original inhabitants.

It must not be imagined that these tree movements are things of the past. Like all the evolutionary processes of nature, they are going on as much to-day as they ever were. Within a generation the wild red cherry has spread from the eastern to the western United States. Botanists who accompanied early government exploring expedi-

tions failed to find any specimens of this tree in Kansas and Nebraska, states where it is now quite common. In many parts of the country second and third growth trees are entirely unrelated to the original timber. The Catskill Mountains of New York when first visited by white men were largely covered by spruce and hemlock. Such areas as have been cut over have nearly always been taken possession of by beech, maple and birch. Of late years it has been noticed that poplars and aspens show a strong disposition to grow up in abandoned clearings. By noting the tree species on a particular piece of woodland, a person familiar with the Catskills can usually tell whether it is first, second or third growth.

This is a striking example of the selective power exhibited by the trees in choosing where they shall live. Some authorities claim that the trees have established a natural rotation of crops. When the pines and the spruces have exhausted the surface soil with their wide-spreading roots only a few feet under ground, the oak comes along and, with its deep-travelling nutriment-suckers, taps the lower-hidden food supplies. By the time the sturdy acorn-bearer has become old and grey and descended to the grave, the once impoverished surface-soil has recouped itself with many generations

of leaves, twigs and miscellaneous dead things and is quite ready to take on a new batch of evergreens. It would seem that this theory is at least somewhat borne out.

Just how do trees travel? It would be a mighty and awe-inspiring spectacle to see some great forest striding across the country, but except in some such cases as Macbeth's Birnam Wood, this has never been recorded as taking place. The trees have chosen a less sensational and more scientific method of locomotion. They prefer to travel in embryo and by means of tiny fruits and seeds light enough to fly through the air or float on the water, transport future forests half way around the globe.

To-day it is possible for a man to travel on land, on water, on ice, in the air and underground. It has taken him many hundred centuries and much cerebral effort to perfect these accomplishments. The trees were making use of all these modes of travel when man's long-tailed ancestors were just beginning to swing in their branches. Flying, which is man's weakest and latest art, is, strangely enough, the trees' favourite transportation device. They have invented many types of flying machines, and though they depend on the wind for propulsion, they are often able to send their seeds to

greater distances than man's motor-driven aeroplanes have ever flown.

All summer long a great many trees devote their principal energy to maturing their seeds and providing them with some sort of flying apparatus. Those of the ash have paper-like wings. The seeds of the elms and maples are equipped with membranes as gauzy and delicate as those of a dragon fly. Willow, poplar, and catalpa seeds are attached to tiny balloons. Hop tree seeds have to be satisfied with a kite-like appendage. The spruces, firs, larches, hemlocks, pines and birches produce winged seeds, with a large number coming from a single pod. The alders, tulips, ashes and elms send forth winged boxes—single seeds occupying entirely matured pistils. The parachute-equipped offspring of the pine are given an encouraging push into the world with the bursting of their parent cone. The exploding pods of the wistaria and witch-hazel fairly hurl their children out onto the breeze. Masses of beautifully plumed seeds float from the willows and poplars.

Next to the wind, the trees depend upon birds and animals in getting about the earth. Strange to say, they seem to prefer to ride inside rather than on the backs of their beasts of burden. As a rule, only the lowlier herbs and seeds choose the outside

seats, and by burs and prickles retain a precarious hold on bird or animal. It is quite evident that the spikes of the chestnut and the sharp hairs of the beech are intended more for protection than transportation. All those trees which bear attractive and luscious fruit are contemplating a journey in the dark but safe coach of crop or stomach. Their colours are legion and very brilliant and usually so planned as to contrast strikingly with the green foliage. When the bird or animal has yielded to the allurement of rosy skin and juicy pulp, the seed's trip is begun and it can try to imagine just where its unconsciously obliging vehicle will carry it. The embryo trees are all specially equipped for their sojourn in their host's digestive tract. In the orange they are hard and bitter and have a glutinous coating which makes them slippery and sure of being swallowed whole. Plum, peach, and cherry stones have coverings hard enough to defy the strongest teeth. The protection in apples and pears is not so good, though the tough coating is often rejected and so escapes digestive incarceration entirely.

Nuts also prefer the outside route. In fact, they have everything to lose by being eaten. The all-important germ of life is contained in the edible matter. It would seem to be a case of nature sac-

rificing the many for the good of the few. Squirrels and small burrowing animals bury thousands of nuts each year in order to soften their hard shells. When this is accomplished many of them are eaten, a few are forgotten and so, being already planted, grow into trees. Large numbers of walnuts, pecans, chinquapins, acorns, and hickory nuts are distributed this way. Strange as it may seem, whole persimmon groves are sometimes started near a hollow tree where an ambitious opossum has reared a family and scattered the seeds around his home. A hollow at the foot of an old oak, the home of many squirrels, often sends up a small forest of oak shoots from buried nuts.

However, it must be admitted that animal-riding is only a secondary or last resort locomotion of nuts. Their plan seems to be: avoid detection if you can by colouring yourself green while on the tree and brown while on the ground. Protect yourself with burs and bitter rinds. When you fall, endeavour to roll down hill or float on the water. If you are carried away by an animal, you travel much farther and are planted gratis, but you run the chance of later being dug up and eaten.

The unicorn nut is one of the few enthusiastic animal riders. It has a special apparatus for attaching itself to the feet of animals. Most Amer-

ican nuts, especially those like the hard-shell walnuts, are unfitted for long journeys. They are unusually rich in oil which easily becomes rancid. Even when buried, they are more liable to decay than to sprout.

The nuts are enthusiastic sailors. Not a few are built along nautical lines and when dropped into the water at once become small but seaworthy boats. The cocoanut, the cashew and the mahogany all make ocean voyages. Cocoanuts are covered with a thick husk, and this husk has a waterproof envelope of hairs. As they float, the three "eyes" seem to always remain on top. As soon as the nut falls into the water a tiny shoot peeps from one of these eyes and sends forth big leaves, which act as sails to waft the craft along. Finally roots begin to peep forth from the other two eyes and in a short time this lucky passenger with sails and roots is ready to land on an island and start to developing into a genuine cocoanut tree. The cocoanut is such a good sea traveller that it has planted colonies on almost every reef in the warmer waters. However, the cashew excels it in marine equipment. The cashew has a double hull and an inner skin. Between the outer and the inner shells circulates a black, waterproof juice, which Maud Going aptly terms "calking between decks." The bladdernut

lacks this equipment but possesses water-tight compartments which have no bulkhead doors for a captain to remember to close. There are other nuts and seeds which buoy themselves up with air-chambers and oily skins.

It is quite certain that these tree-voyagers make trips quite as long as those of man. The Japanese black currant is continually landing Asiatic seeds on the shores of Oregon and Washington. A certain West Indian seed of large dimensions drifts onto the shores of the Hebrides quite often. All these are small craft, but exceedingly seaworthy.

Even the frost-filled wastes of the frozen North offer no barrier to the tree-travellers. Propelled by the strong winds of such regions, trees like the honey locust send tiny ice-boats scurrying across the frozen landscape at a mile-a-minute speed, while others stick to the slower and more common air route.

While it is true that trees never walk across the landscape at a speed which is visible to the eye, they do by the slower processes of growth actually move over the surface of the earth. Sometimes they do their travelling under ground, like the rubber and persimmon trees. These forest denizens, instead of leaving it to their children to enjoy the advantages of new locations, send out long side roots

THE MONKEY-BREAD TREE HAS TRAVELLED FROM AUSTRALIA TO DWELL AMONG THE COCOANUT PALMS OF FLORIDA

THE HARDWOOD'S HAVE INVADED VIRGINIAS BLUE RIDGE

which form the bases from which new trees spring. If the old section dies or the connection is severed, the tree may be said to have literally walked the distance separating the two.

The mangrove does the same thing above ground. Standing knee-deep in the water, it often sends down shoots from its arms, which, taking root, are the beginnings of a new tree. The willow accomplishes the same thing by bending over until one of its branches takes root. Frequently all of the energy of the tree is devoted to the freshly started sapling, so that the old trunk at length withers and dies. But the tree lives on new and fresh, removed to the lot next door. It is said that a freshly felled willow, if used to bridge a small stream, will grow into the banks at either end and make the structure particularly secure.

Full-grown, mature trees may not actually walk across the landscape, but they do swim. There are many records of floating islands which not only make voyages up and down rivers but occasionally embark on ocean trips. At the mouth of the Amazon River sections of land frequently break off and float serenely out to sea. Needless to say, many of these adventurers succumb to the fury of the waves' bombardment, but there have been observed instances when they reached port safely. Nautical

movements on inland waters are more apt to be successful. The trees which grow on such floating islands may be said to travel in the most literal sense of the word.

The trees travel a little slowly, and uncertainly, from our way of thinking, but they get there just the same. Most of man's travelling is done by defying and subjugating the forces of the universe. The trees seem to have a better understanding with the laws of nature; they put themselves in her power and accept her decree as to where they shall go.

X

MUSICAL TREES

Yon breezy pine, whose foliage shades the springs,
In many a vocal whisper sweetly sings.

—THEOCRITUS.

TO the lover of nature the sounds of the mountains and the forests are notes in the greatest symphony ever written. What the ordinary man speaks of as buzzing bees, running water, singing rocks, murmuring pines, or rustling leaves, the outdoor connoisseur recognises as different instruments in the great orchestra of the infinite. To him every mood of nature has its individual song. Even different spots have their regular musical tones to be scientifically identified with a tuning-fork.

Such a man's only regret is that his perceptive powers are so limited. When he thinks of all the natural noises produced every day which are either too slow or too fast in vibration for his rough ears to hear; when he realises the hundreds of musical intervals between A and B which his limited faculties cannot distinguish, he is eager to more thor-

oughly appreciate all the good things he can hear.

Every day in every forest a free concert is in progress. There are no chairs and no programmes (and unfortunately often no audience), but music of a divine order is in the air. The repertoire ranges all the way from the *crescendos* of the tempest to the *lento sostenutos* of a summer's afternoon. Overtures, anthems, masses and requiems all have their turn. Every twig and leaf rustles a glad accompaniment.

The running brook sings in all voices from a piping treble to a tolerably deep bass. The rain pelts melodiously on the dry leaves. Insects, birds and animals make their harmonious contributions. The wind and the trees play an entire symphony by themselves.

But it is the musical efforts of the trees in which we are most interested. Very few of them are self-playing. They are mostly docile instruments in the powerful hands of the wind-god. Each has its range and its tone. The musical possibilities of each vary with the seasons. Ordinarily, the music of the trees is soft and caressing, but there are times when they are called upon to wrestle with the tempest. Under the cruel lashings of an aroused element, their song rises into an inferno of wailing. Nothing strikes terror to human hearts

quicker than when the trees shriek their plaint into the night air. The boughs creak and roar like frightened animals, and twigs snap like over-strained strings, while the leaves howl dismally. Melody is transformed into chaos.

Dr. Hartwig in describing a storm in a forest says: "A hurricane bursting over the primeval forest is one of the most terrific scenes of nature. A hollow uproar in the higher regions of the air, as if the wild huntsman of the German legends were sweeping along with his whole pack of phantom hounds, precedes the explosion of the storm, while the lower atmosphere still lies in deep repose. The roaring and rushing descend lower and lower; the higher branches of the trees strike wildly against each other; the forked lightning flashes through the night-like darkness; the thunder, repeated by a hundred echoes, rolls through the thicket; and trees, uprooted by the fury of the storm, fall with a loud crash, bearing down every stem of minor growth in their sweeping ruin. The howlings and wailings of terrified animals accompany the wild sounds of the tempest."

Under such conditions, it is hard to distinguish the notes of the individual singers. A gentle breeze is better calculated to bring out their vocal accomplishments. The pines are very noticeable for the

exceptional quality of their music. Like miniature harps and guitars, their myriad needles tinkle with the slightest motion of the air. The gentle whisper of their orchestration may be heard on all but the very calmest of days. In a stiff breeze, the pine needles become the reeds of a mighty pipe-organ. In a storm they give forth a thunderous moan. It has been noticed that wood doves and pigeons delight in the music of the pines.

Another small-leaved tree which produces delicate, voice-like music is the oleander. In Galveston, Texas, the "Oleander City," under the influence of the breezes from the Gulf of Mexico, they play and sing all night. The trembling aspen and most poplars produce a clear tinkling which sounds a great deal like bells in the distance. The weeping willow, on which the captive Jews hung their harps in Babylon, sighs and moans afresh for Israel in every summer zephyr. Oaks and black gums are rather melancholy trees, often caught with a peculiar sigh on their leaves.

When the giant redwoods of California wrestle with the storm-wind, they roar and bellow like a herd of enraged elephants. The cedars, caught in the vortex of a gale, whistle with the note of a high-powered wireless transmitter. The mangrove produces a grunting sound when the wind plays

THE GIANT DOUGLAS FIR AND RED CEDAR COMBINE TO FORM A MIGHTY PIPE-ORGAN

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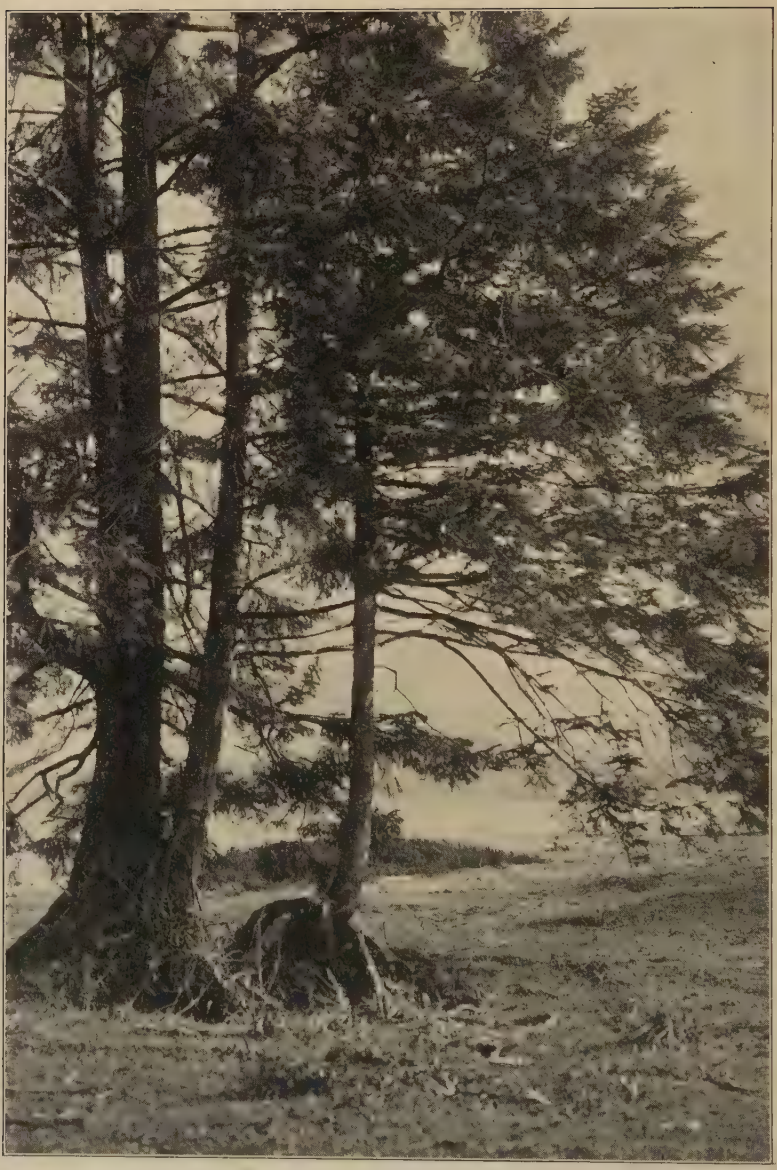

THESE CONIFERS CATCH WHISPERINGS FROM OFF THE RIVER

on its aerial roots. The branches of elms and maples flop and snap with the noise of a hundred kettle drums, while the cottonwood gives forth a weak hissing sound.

Large-leaved trees, like the tropical palms, have the regular place of drummer assigned to them in all weather. Their heavily moving leaves give a very good imitation of the weird effects produced by a human master of the traps. To the banana is given the rôle of bass drummer. These creatures, which are practically all leaf, flop their huge sections about with thunderous effect. Our northern hickory is another tree which likes to rattle.

The trees are not altogether dependent upon their leaves for their music. Not a few play their most alluring compositions in the autumn and winter seasons when the leaves are on the ground. The tulip tree is a frequent late autumn performer. When its seed pods burst open they disclose thousands of tiny, circular instruments upon which the wind plays the most weird and enchanting music. The winter music of the Chinese umbrella tree is a melodious laugh, so imitative of the sign of human mirth as to earn for the player the name of "laughing tree." There is a certain simplicity and directness of theme about winter tree music which the

confused rustling of leaves often prevents in the summertime.

It is perfectly possible to recognise a tree by its musical notes, though varying factors make a large amount of practice and ear-training necessary. The tone of a tree depends on its size, height and location, that is, whether it is acting as a soloist or as a unit in a vast orchestra. For all that, sounds produced by different varieties under ordinary conditions are strikingly dissimilar. One would never mistake the murmuring of the pine for the dismal howling of the catalpa, nor the whinnying of the sassafras for the hissing of the osage orange.

Men and women who cannot sing, or play upon some stringed instrument, are very apt to seek the services of those who can. It is not stretching the comparison too much to say that the trees do the same thing. So fond are they of bird and insect music that they often entertain and protect their winged songsters even when their own musical abilities are not undeveloped. Instead of the choirs of human cities, the cottonwoods of the tree cities house and shelter hundreds of song birds. Instead of piano-players, the elms employ tree frogs. With the ash, katydids and crickets take the place of stringed quartets.

Besides the sylvan musicians who actually make

their homes in the trees, there are in every forest myriads of humble dwellers in moss and grass who have their individual little songs to sing—tiny contributions to the great symphony of the great outdoors.

In the tree world music undoubtedly reaches its highest development among the birds. Though some of their songs are short in range and variety, they are often indescribably sweet and almost always in perfect keeping with their surroundings. The mocking bird has no rival, and he sings both day and night. In the forest most birds welcome the glad beginning of each morning with a burst of melody, quiet down during the heat and drowsiness of midday and later indulge again in their evening song. In the lull just preceding a storm the cry of the white-throated sparrow may often be heard. It utters a half-dozen sweet, plaintive notes which are exquisitely interpretative of the hour. When watching a storm from the shore of a lake one can often hear the demonic laughter of the loon high above the howling wind. Like a kite above the water it soars, in very shape and embodiment the spirit of the gale. In the quiet coolness of a summer evening what is more in harmony than the liquid notes of the thrush?

Everywhere one goes in a forest he finds myriads

of tiny insect musicians; bees, wasps, hornets, flies, beetles, and even mosquitoes—all these are truly musicians. The honey locust tree keeps a small musician, the cicada. So skilled is he in producing music that the old Greeks often caged him for his song.

We see that trees as well as all other beings are fond of music. Their intonations and modulations do a great deal for the man who is travelling through the wild. They beautify and spiritualise his thoughts. They lift him for a little while to higher planes where he may contemplate the better things of life.

XI

HISTORIC TREES

"Wise with the lore of centuries, what tales, if there were tongues in trees, that giant oak could tell."

IN the little village of Santa Maria del Tule, Oaxaca, Mexico, stands an aged and decrepit cypress tree. It occupies a place of honour in the central square and is carefully fenced against vandalism. The people of the village and surrounding country hold it in the greatest awe and veneration. They claim that it is the oldest living thing in all the world and scientists qualified to judge are inclined to agree.

There are so many trees on this round earth of ours and their records are so obscure and conflicting that the task of picking out the very oldest is more than Herculean. The more conservative experts are content to say that this cypress at Oaxaca is exceedingly ripe in years and certainly in the very front rank of candidates for the first honour. Others are quite convinced that no other living tree can present greater evidences of antiquity. The

layman is sufficiently impressed by reflecting that this vegetable growth has existed as a single life ever since the dawning of history.

Every one agrees that the hoary monarch first burst through its seed walls somewhere between five and six thousand years ago, which would make it contemporaneous with the first records of civilised man. When the Egyptian Cheops was piling the great pyramid up toward heaven this antiquarian had developed into a vigorous sapling. When the Israelites fled the bondage of the Nile for the valleys of Canaan, it had doubtless attained its full height and put several centuries behind it. All through the rise and fall of the great Greek and Roman epochs, all through the obscure years of the Middle Ages, all through the vicissitudes of so-called modern history, the cypress has lived out its placid existence, faithfully adding a new ring of wood to its increasing girth each year, until today one has to run the surveyor's tape out for one hundred and twenty-six feet to encircle its trunk at a point four feet above the ground. Recent visitors state that the wooden tablet which Humboldt nailed to the trunk when he discovered the tree in 1803 is still intact, though half covered with bark and with its inscription well-nigh obliterated.

Another tree of extreme age, which has the added

distinction of being regarded by many as the world's largest tree, is situated in the Valley of Aragua in Venezuela. It is called the Zamang de Guerro, after Christopher Guerro, who discovered it during the sixteenth century. It was visited by Humboldt about 1800 and made famous by him throughout the world. It is said that its far-reaching branches form a circumference measuring five hundred and sixty-one feet. It is made very beautiful by the orchids and other tropical parasites which hang from its boughs.

It should not be imagined that these two trees are examples of a caprice of nature which occasionally allows isolated specimens to grow for many centuries beyond their allotted time. While the average life of the common trees of our streets and gardens is not greatly in excess of that of a human being, there are whole races of trees which, like the man-giants of old, live for incredible periods of time.

There are hundreds of sequoia and redwood trees in California which are between three and four thousand years old. Almost all of them which have been cut down show wood which is remarkably hard and free from decay, indicating that the species may live to double their present age if given the opportunity. Furthermore, it is claimed that

there are junipers in Oregon with an estimated age of six to eight thousand years. If this is true, the junipers have not been receiving proper credit as long livers, and the honour of sheltering the oldest tree may go to the United States rather than Mexico, after all.

Another long-living tree race is the yew, which exists from 1200 to 2800 years; the olives live from 700 to 2000 years; the oaks, from 600 to 1400, and the walnuts from 900 to 1000 years. How insignificant are our lives compared to these! Such figures represent averages and do not take into account especially hardy and well-favoured individuals which sometimes live to almost double their "four-score years and ten."

If we only understood the language of the trees better, what a revision of history there would be! There are in existence to-day different trees which began their lives in all the correspondingly different periods in the biography of man. If each one had taken particular notice of the customs and events of the time in which it was born and then was able to communicate these impressions to men, the result would be a contemporary living history of civilisation. Each tree would be an authority and, instead of searching in ponderous tomes to discover whether Charles II of England spoke in a deep bass or a

BECAUSE OF ITS LONG LIFE, THE BEAUTIFUL CYPRESS OFTEN BECOMES HISTORICAL

A FAMOUS WEST INDIAN SAMAN OR RAIN-TREE OF TREMENDOUS PROPORTIONS AND EXCEPTIONAL GRACE

high treble, we should cable to the Royal Oak at Donnington in Shropshire which sheltered him and listened to his hysterical lamentations after his defeat by Cromwell at the Battle of Worcester. An eye-witness for every event in the world's history! What a millennium for truth and veracity!

Next to the buildings of men, trees are the most historic things in existence. All over the world are venerable forest monarchs which men honour and reverence as being associated with some great man or event. England, especially, is unusually rich in historic trees. There almost every feudal estate boasts of one or more of glorious memory. Among the most famous is the King's Oak at Woodstock. It is situated on the former hunting lodge of Henry II, where that ruler spent many happy hours with his favourite Rosamond. It bears the added distinction of having been associated with King Alfred, the Black Prince, Chaucer and Charles II.

There is a pretty story connected with an oak on the grounds of Hatfield House, the ancient manor of the Cecils on the River Lea. It was under this gnarled giant that Elizabeth was seated when she first heard of the death of her sister, Bloody Queen Mary, and her own accession to the throne. It is related that she was reading the Greek

Testament at the time, doubtless seeking consolation for her virtual imprisonment at Hatfield. As she read, a courier on horseback approached along the London road. Catching sight of the Princess, he quit the course which was taking him toward the castle and, running to Elizabeth, acquainted her with the portentous news. It is not stated whether the Virgin Queen wept or solicited congratulations. Only the oak knows—and a tree tells no secrets.

Another of England's trees of note is the 1500-year-old Major Oak in Sherwood Forest, which is said to have been the favourite rendezvous of Robin Hood and his merry men. Then there is the Parliament Oak of Clipstone Park where Edward I is alleged to have once convened a national assembly. In reading of Britain's famous trees, the predominance of the oak is very noticeable. This is doubtless due to the very abundance of the species and the special reverence with which the worship of the Druids endowed them.

The history of America is short in time but mighty in deed. It also has had its noteworthy trees, but, in most cases, it has been unfortunate enough to choose trees of the non-enduring kind or has failed to develop enough historic sense to take adequate steps for their preservation.

The Washington Elm of Cambridge, Mass., is

practically the sole survivor of a number of venerable trees associated with events of national importance wrought in the infant days of the Republic. And now in these last days arise experts who even question the absolute authenticity of that monument's claim to fame!

Be that as it may, most Americans are content to believe that on July 3, 1775, General George Washington assumed supreme command of the armies of the rebelling colonies under the shadow of the failing but still grand old elm which occupies a prominent place in the city by the Charles. Let us honour it while it is still with us. There are indications that its days are numbered. Already the expert care of Professor Sargent of the Arnold Arboretum has prolonged its life many years. There is excellent reason to believe that Washington's Tree deserves further reverence as a pulpit from which George Whitefield at one time preached when excluded from New England towns and colleges in 1744.

On August 21, 1856, a light gale blew down a stately 2000-year-old oak near Hartford, Conn. The next day a whole city mourned around its prostrate trunk and, under official direction, converted every scrap of its wood into sentimental mementos. This was the tree which for one hun-

dred and sixty-nine years had been hailed as the preserver of the liberties of the Colony of Connecticut and as the "Charter Oak" had attained country-wide prominence. The story is contained in every school boy's history-book, but possibly we can enliven it with fresh piquancy by imagining that the tree related the tale with its own leaves a year or so before its death.

It waved its upper branches a little grandly as it began. "For many months in the year 1687 I was all that stood between the people of Connecticut and tyranny. On October 31st of that fall one Edmund Andross appeared before the colonial assembly at Hartford and demanded that it surrender to him its royal charter. He spoke as the governor-general of all New England, having been just sent out from the mother country in that exalted capacity by the recently crowned James II. He had been ordered to confiscate all charters heretofore granted and to rule only as the King decreed.

"The assembly received Governor Andross courteously, even aimably, and settled down to discuss the matter. So well did they argue that the conference ran on into the evening and the time for the lighting of candles. When it had become quite dark the lights were suddenly extinguished

by prearranged signal and in the resulting confusion the charter was deftly borne away by a patriot named Wadsworth. In vain did Andross storm, declare the assembly dissolved, write *Finis* on its journal and order his soldiers to seize its records. The charter had been carefully hidden in a large cavity near my roots, and when, in a few months, James II was driven from the English throne and Andross from New England the colonists relieved me of my charge. English jurists decided that as the charter had never been yielded up it was still in effect. Thus was Connecticut liberty preserved for sixty-nine additional years, when intolerable injustices in other directions made concerted revolt by all the colonies necessary.

"Soon after my important duty had been performed, the entrance to the hole which had held the precious document began to close up, as if to indicate that its mission was ended. You can see that now only a slight crevice is left."

And having finished its narrative, this remarkable tree dropped its leaves in a silence from which the most excited questioning could not arouse it.

Up to 1810 there existed at Shackamaxon, Pennsylvania, now the Kensington section of Philadelphia, a superb elm known as the "Treaty Tree." It was memorable as the place where William Penn

in 1682 concluded his famous treaty with the Indians. This noble Quaker was the first European to carry out in his dealings with the red men the doctrine of brotherly love. They were so impressed that they never broke the verbal oaths made under the Treaty Tree at that time. The monument to the pact was felled by a storm in 1810, aged two hundred and eighty-three years and measuring twenty-four feet in girth.

Down on King's Mountain, South Carolina, there used to be (and possibly may be yet) a splendid specimen of the tulip tree with which is connected a gruesome tale. Near the spot, in October, 1780, a force of South Carolina revolutionists (or Republicans, as they were called in the South), under the command of Cleveland, Shelby, Campbell, Sevier and McDowell, defeated one thousand Tories led by Major Ferguson of Cornwallis' staff. The past crimes and acts of wanton destruction committed by some of the captured royalists had been so disgraceful that they were condemned to immediate death by court-martial. A large tulip tree on the bank of a nearby brook was selected as the scene of execution. To its green boughs ten of the prisoners were hung, giving it an immortal but unenviable fame.

One day in 1849 some obscure farmer near

Charleston, S. C., discovered that he needed firewood and with ruthless hand chopped down a magnificent magnolia tree just outside his door. He thereby lost for the community an interesting relic of the British siege of Charleston in 1780. On April 21st of that year the American General, Lincoln, held a council of war beneath its flower-laden branches. He told his officers and representative towns-people that the enemy had just been reinforced with 3000 troops from New York and further resistance seemed hopeless. He counselled the immediate retreat of the American forces, but at the earnest pleadings of the worried Charlestonians finally agreed to stay. Three weeks later he was forced to surrender. The tree under which the meeting was held was known thereafter as the Magnolia Council Tree.

In the days just preceding the Revolution a number of New England towns had their "Liberty Trees." These were usually elms and were used as rallying-points for speeches and burnings in effigy. Boston had a fine one at Washington and Essex Streets. The one at Providence was especially large.

For many years visitors to Haverstraw, New York, were taken a few miles out into the country to see the black oak under which "Mad" Anthony

Wayne mustered his men in preparation for his brilliant capture of Stony Point. This was the same general who once told Washington that he would storm hell itself if the chief would draw the plans. In a later day Vicksburg and Appomattox, where General Grant received the swords of Pemberton and Lee respectively, each had its surrender-tree.

On the estate of General Villeve, a few miles below New Orleans, there used to be a leafless pecan tree to which was attached a blood-curdling story. After the battle of New Orleans, January 8, 1815, the British loss was found to include General Packenham, commander; General Gibbs and Colonels Dale and Rennie. It was decided to ship the bodies of all these men to England, preserved in casks of rum. Part of the preparation consisted in removing the internal organs, which were promptly buried. The viscera of General Packenham were interred under the pecan tree already mentioned. It is solemnly averred that the sympathetic nut-bearer dropped its leaves at once and superstitious negroes for decades pointed to blood stains on the trunk.

Of more peaceful interest are the two big white oaks which stood on quiet Bowne Avenue, Flushing, L. I., seventy-five years ago. They marked

the place where a great concourse of people came together near the house of John Boune to hear the great Fox, founder of the Quaker sect, preach. This was in 1672, when the evangelist was making a brief tour of some of the American colonies. One of these most memorable trees fell in September, 1841. The other was reported dead but still standing in 1861, aged about four hundred years.

What historic trees there are on the great central plains between the Mississippi and the Rockies are mostly cottonwoods. Such is a fine specimen in the capitol grounds at Topeka, Kansas. It sprang from a seed in 1869 and has now attained a height of eighty-five feet and a spread of one hundred feet. Its trunk measures twelve feet in circumference. This tree is well beloved by all loyal "jayhawkers," especially as it was the mustering and distributing place for the Twentieth Regiment of Kansas Volunteers which made such a fine record in the Philippines.

It is usually difficult enough to obtain an accurate record of a single historic tree without delving into leafy family history. Yet fifty years ago circumstances made the genealogy of a certain weeping willow of New York City so apparent that its line has been traced clear back to Asia. The story all turns upon the thoughtfulness of a friend

of the English poet, Alexander Pope. This man, while travelling in Smyrna, sent the lame genius a box of figs. In the box was a twig of the weeping willow botanically known as *Salix babilonica.* In a spirit of curiosity Pope planted the twig at his estate of Twickenham on the Thames. In the course of time a stately and magnificent tree developed. Struck by its decorative grace, a British officer coming to America in 1776 begged a twig of Pope's willow. It was his intention to plant the stick on an estate to be confiscated from some defeated colonial. As things turned out, the Britisher did not get his estate and in chagrin gave the slip to John Curtis of Virginia. The latter promptly planted it and successfully raised a beautiful specimen of the tree.

It is said that this tree became the progenitor of all the weeping willows in the United States. At any rate, when General Gates leased a farm at Rose Hill, New York, in 1790, he planted at his gate a slip from the willow. The young tree prospered and as a venerable greybeard lived long after Rose Hill had been swallowed up by the expanding city of New York. For many years it stood at the corner of Third Avenue and Twenty-second Street, but at length, in 1860, fell a victim to the march of time and the Park Department's axe.

Another tree resident of Third Avenue, which survived the Gates willow by a number of years, was Peter Stuyvesant's pear tree. It lived at the corner of Thirteenth Street, at the exact spot where the old Dutch governor's country estate used to be. Old Peter himself is supposed to have planted the tree with seeds or shoots brought from Holland. In 1862 the tree was reported to be at an advanced age, minus most of its branches and most of its leaves.

Among other historic trees of former days in the Big City was the group of cypresses at the old Jumel Mansion near 159th Street. They were a present to Mr. Jumel from Napoleon, who imported them from Egypt. In 1802 Alexander Hamilton planted thirteen gum trees at his country seat outside the city to represent the thirteen colonies. Though carefully looked after, they steadily declined throughout the century. When the last one died in 1908 it found itself in the centre of the metropolitan up-town residential section at Convent Avenue and 143d Street.

Still standing on the Mall in Central Park is an American elm started by Edward VII when on a visit to New York as Prince of Wales in 1860. He planted an English oak alongside the elm to indicate the friendliness of the two peoples, but

despite the utmost care the oak died in 1909. Since then another tree of the same species has been set out to take its place.

It will not do to linger too long in New York. The whole world is our field and we must briefly consider a few celebrities of Europe and Asia.

The ancient Hebrews were such a religious people that, ordinarily, we could expect to find many historic trees in their country. Unfortunately, Palestine has been largely denuded of its splendid Biblical groves. Only isolated groups here and there cheer a barren landscape. One of these is the famous Cedars of Lebanon. These magnificent trees are first cousins to our gigantic redwoods, and are actual contemporaries or descendants of the forest monarchs used in the construction of Solomon's Temple. There are very few left to-day in the sacred enclosure maintained by the Maronite Monks. A circular group of twelve is called "The Twelve Apostles," on the strength of the legend that they sprouted from staves left upright by Christ's religious family while passing that way. At Hebron may be seen Abraham's Oak, where the First Patriarch received the "heavenly visitors." This tree is ten feet in diameter and has many admirers who claim it is the oldest of its race.

The Greeks can point out an ancient olive tree

under which Plato and Socrates are said to have once had a particularly animated discussion. St. Paul is also credited with having rested under it on his memorable journey to Athens. This vegetable greybeard is two thousand years old, but still bears fruit. On the Island of Ceylon is a sacred bo-tree which authentic records indicate was planted 228 B. C. It is carefully guarded and never touched by human hands, though pious pilgrims may catch the leaves as they fall.

Coming into Europe, there are a whole host of trees held in historic veneration. The ancient oak of Guernica in Spain is a noteworthy monument. Under its leaves Ferdinand and Isabella, in 1476, made oath to the Biscayans to faithfully maintain the privileges of the subject race. In 1810 Wordsworth visited the tree and wrote a sonnet to it. The Sultan's cypress in the Generalife Gardens in the city of Granada is also associated with the patrons of Columbus. Irving describes in his *Conquest of Granada* how, when the royal pair entered the city at the head of their troops, the wife of Boabdil, the last Moorish Sultan of Spain, took refuge in its trunk.

At the Cathedral of Hildesheim, a small city sixteen miles south of Hanover, Germany, is what is claimed to be the oldest rose tree in the world.

Its credible history goes back one thousand years to Charlemagne and the ninth century.

Everybody has read the story of Rollo's Oak. That doughty Scandinavian wrested a large slice of coast country away from the French King and became the first Duke of Normandy about the beginning of the eleventh century. One day he hung a priceless gold chain on one of the trees in the royal park, asserting that so well had order been established in his new domains that no one would dare molest it. The boast held good for one night at least and the tree in consequence has lived an honoured life down to this day. It has become very weak in recent years and almost collapsed several times. Under the direction of some skilful gardener it was still later furnished with a new inside of masonry and promptly took on new life.

On this side of the water and excluding the United States, there is the Surrender Tree at Santiago de Cuba, where Spanish arms yielded to American prowess in 1898. This landmark is a giant ceiba or silk cotton, as is the tree in Havana which is venerated as a direct descendant of the ceiba planted by Velasquez to commemorate the founding of the city.

In Chapultepec Park, summer residence of the Mexican presidents, is a giant cypress of Herculean

proportions with an estimated age of six thousand years. Both Montezuma and his Spanish conqueror, Cortez, are believed to have sat under it. During the war between the United States and Mexico Major Lee and Captain Grant once met there. Little did they know that they were to become the two principal opposing generals in the greatest civil war in history.

Is it necessary to adduce further proof to show how intimately the trees are bound up with the progress of man on this whirling sphere of ours? Since the beginning of time when Adam and Eve lived in the Garden of Eden among the trees, we have instinctively turned to them as the best and most sympathetic symbol of the life and force which persists through eternity. They are silent but efficient chroniclers.

XII

RELIGIOUS TREES

"The groves were God's first temples."

TREE worship is probably one of the very earliest forms of divine ritual. Sacred trees appear in the most ancient mythologies and linger in the last remnants of heathenism. Even Christian practices have not failed to recognise man's inherent reverence for the trees.

No one knows exactly how tree worship started, but it is easy to hazard some very plausible guesses. A belief common to many primitive races is that anything which exhibits life or force must possess consciousness or a spirit. A thing so majestic, so inspiring as a tree, which ordinarily lives so much longer than a man and so is associated with both the distant past and the hazy future, would easily win early man's adoration. It was also the habit of our primeval ancestors to worship the natural sources of their benefits. Inasmuch as the sun which warmed them by day; the moon and the stars, which lighted them by night; the rain, which cooled

and refreshed them in times of heat, were all objects of their worship, why not the trees, which also protected them from the noon-day sun and with their fruit, bark, leaves and sap often clothed their bodies, built their houses and furnished their food?

The lofty and spiritual appearance of many trees would also tend to excite reverence. The slenderly tapering loblolly bay, with its ethereal leaves and pure white blossoms, is a veritable call to worship. Its wax-like flowers are candles on nature's altar.

It is reasonable to assume that only during the veritable beginnings of the human race were trees the direct recipients of man's worship. It was not long before certain trees became the sign and symbol of more remote forces and deities, and their groves the temples in which devotion was shown. The trees were often regarded as the actual abode of certain spirits—sometimes gods to be adored and revered, sometimes spirits or demons to be feared and appeased.

It is a curious fact that many of the great religions of ancient peoples converge upon the conception of a divinely endowed tree guarded by a serpent. This tree was usually the tree of life and knowledge and sometimes the upholder of the world. The tree of life in the Garden of Eden and the Scandinavian tree of the universe have points

of similarity. That both the Scandinavians of northern Europe and the Algonquin Indians of North America should have believed that man was originally created from an ash tree is a remarkable coincidence. Even those religions which do not give the trees such a prominent place, make frequent and complimentary allusion to them. The conception of paradise as a garden is frequent. The word *Bible* itself means papyrus bark. The Brahmins have a very beautiful saying which shows that the sandal-tree by perfuming the axe which lays it low teaches that we should love our enemies.

Conventionalised representations of sacred trees appear on the Chaldean cylinders of 4000 B. C. and so trace the trees' connection with religion back to the earliest human records yet discovered. All the great races of antiquity also accorded them a place. The sycamore was held in veneration by the Egyptians and worshipped with fruit offerings and jars of water of which travellers might partake. The Persians believed certain trees to be the dwelling places of gods and the haunts of good and evil spirits. Sacred trees appear in most of the ancient sculpture and painting of Assyria. The date palm, fig, pine and cedar are all represented as trees of life at which the gods got their strength. The palm was holy in Arabia. Brahma of India made

LOBLOLLY BAY. *Gordonia lacianthus.*

The wax-like flowers of the loblolly bay are candles on nature's altar.

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the fig sovereign of the trees. The Mohammedans still honour the date.

In Biblical times the Canaanites planted a sacred tree beside each altar, and the Israelites, adopting their custom, set up sanctuaries under the shade of groves, which were also emblematic of the Garden of Eden. It was when the worship in these groves took on a form still more like that of their heathen neighbours, that the thunderous denunciations of the prophets were so often aroused. It is recorded that the voice of God came to Moses from a burning bush, which might be taken as an indication of the belief in trees as oracles. The olive was reverenced by the Hebrews. It is said that the cherubims of the ark were carved from its wood. The golden palm was regarded as a mystic tree by both the Jews and the Arabs. The species of that day were said to rustle their leaves even when no wind was stirring. This was looked upon as a form of prophecy which those skilled in "the language of the palms" could interpret. It is believed that Abraham was well versed in this art and that Solomon planted some of these wonderful trees in his temple. The fact that Abraham "received heavenly visitors" under an oak, that the angel spoke to Gideon from under an oak and that Isaiah rebuked

the Israelites for their idols under "every thick oak" may be of significance.

The Greeks of 1500 B. C. are believed to have worshipped gods in tree form. The oracle of Zeus at Dodona was in a grove of oaks, and was itself an exceptionally fine specimen of that majestic race. It answered questions by rustling its leaves, murmuring through the spring which bubbled from its base, by influencing the drawing of lots from the urn at its roots and by causing certain brass vessels which hung on its boughs to clash together. Of course, there was a whole corps of priests and aged women for the interpretation of these cryptic messages. All that was necessary to set the séance in session was a good, stiff breeze.

Classic literature and mythology are full of other references to the divine aspects of trees. Some authorities say that, preceding the statues in the Greek temples, were carved posts representing tree trunks. It was a poplar tree which cured Hercules of his serpent bite. After a world-wide search he found it in Spain. The Pillars of Hercules were raised to commemorate the event. In Greece, the pine was sacred to the memory of Poseidon and Dionysus. Birch wood was always used to make the fasces of the Roman magistrate. Perhaps that is why a birch rod is still held to be a schoolmaster's badge of au-

thority. Among the fruits the apple is the favourite of the classic writers. Aphrodite holds it in her hand and Ulysses longs for it in the Garden of Alcinous.

It was with our European ancestors that tree veneration reached its highest expression. The Scandinavians believed that the destinies of the earth lay with their tree of the universe—Yggdrasill. A whole mythology explained how certain actions of the birds and animals which dwelt in and around it affected affairs in the world of men. Yggdrasill was an ash, as was the progenitor of the first men. It is related that the god Odin and his brothers, while walking by the sea, came upon two striking trees. In some sort of creative impulse, Odin changed them into a man and a woman. The ash (ask) became the man and the elm (embla) the woman. This suggests why tree and ancestor worship are sometimes blended.

Next to the ash, the oak was the most sacred of northern trees. It was recognised as king of the trees and the representative of supernatural strength and power. Laws of the early Saxons protected it from injury. Because so often struck by lightning, it was believed to be the special tree of Thor, the thunder god. The ancient Britons also held the oak and the mistletoe which grew on it in

special awe. To them, a gnarled and shattered oak was the most mystical thing in the world—and probably it is! As an indication of the personal regard which primitive people have for certain trees, witness the fact that not more than two or three centuries ago it was the custom in certain parts of Westphalia to make a formal announcement of each death in a family to the nearest oak.

There was a great mass of superstition and peasantry practice in which various trees figured throughout the Middle Ages. In Europe and occasionally in England, it was believed that a child could be cured of rupture by passing it through a split oak branch. The tree-wound was bound together and plastered up with clay or loam. If it healed, the child likewise would be cured. The linden was long considered sacred in Germany and was looked upon as the habitation of the goddess of Love. The people of the same country also revered the elder and associated it with Huldah or Hilda, the mother of the Elves. It is quite curious that despite its prepossessing character, the walnut was generally believed in the northern countries to be diabolical in origin and the hereditary enemy of the oak. It was maintained that when these two trees grew close together, one or the other must wither and die.

During all this time, many of the old tree beliefs of the East still persisted or were superseded by others. A very interesting mediæval tree-story comes to us from India. It is said that Tsong Kaba, who later became Buddha, had very beautiful white hair as an infant. For some unknown reason, his parents decided to cut it off when the lad was about three years old. No doubt the child protested, but his head was shaved forthwith and the pretty locks thrown outside the tent. They had not been there long, when lo, there sprang up from them a tree, which exhaled a delicious perfume and bore mystical Thibetian characters on each of its leaves. As can be well imagined, such a remarkable plant at once became the object of adoration. The Emperor Khang-Hi built a silver dome over it to protect it from the elements and as the "Tree of Ten Thousand Images" it became a famous place of pilgrimage. The Abbé Huc is said to have visited it in person and vouched for its genuineness.

So strong a hold had tree worship on the inhabitants of Europe that they carried over certain of their modified beliefs into Christianity. Their ancient woodland gods under Christian influences became elves, sprites, witches, goblins, etc. Individual trees heretofore sacred because of mighty deeds wrought in their vicinity by Thor or Odin now be-

came holy as the place where a saint had performed some marvellous act. The oak was still reverenced as the most sacred of trees, but now, with a cross cut in its bark, was a special protection against man and elfin enemies. As late as the twelfth century, church canons in England and Ireland thundered against an over-reverence for sacred trees.

It is said that when St. Augustine made his famous missionary landing in England in the sixth century, he wisely chose an oak as a pulpit from which to preach to King Ethelbert. Remarkable were the experiences of St. Bonniface with the great "Thor's Oak" in the land of the Hessians. Going on a missionary expedition from England to central Germany, he found the natives standing in great awe of the Tree of the Thunder God. He determined to cut it down and so destroy their reverence. When the great tree was half cut through, the story says that it was shaken by a supernatural wind so that it fell to the ground and divided into four parts. The round-standing heathens recognised this as a miracle and were converted on the spot. As a memorial of the event St. Bonniface built an oratory from the wood of the fallen giant.

Many beautiful mediæval legends grew up to explain the history of the true Cross. One version narrates that the tree on which the Saviour was

crucified came directly from the Garden of Eden. Adam is represented as carrying from the Garden a number of seeds from the Tree of Life. One of these he planted in Hebron. This tree (or its descendants, it is not clear which) was always carefully preserved and protected by the Biblical patriarchs. When the Israelites set forth on their forty years' wanderings Moses carried the tree with him. Established in the land of Canaan, it was the tree under which David sat to compose his psalms. Solomon decided to accord it a prominent place in his temple, but after it had been cut to shape, it was rejected and flung into a marsh where it served as a bridge for many years. After a while it either sunk or was buried in the earth, and from a position beneath the bottom of the Pool of Bethesda imparted healing properties to the water. At the time of the crucifixion, the beam rose to the surface of the pool and was seized upon by the infuriated Jews as a convenient log upon which to crucify the Christ. Records which have some historical value say that the Cross was refound by the Empress Helena in the year 326. It is often stated that the Cross was made of oak, though many legends name cypress, cedar, pine, and box. There is a pretty, though comparatively recent legend, which maintains that the Cross was made from

aspen wood, which explains why that tree has been shivering and trembling in shame ever since. Judas Iscariot is said to have hung himself on an elder tree.

Lest the reader be tempted to relegate tree worship to a distant and shady past, he should know that spiritual reverence for the trees has a wider footing in the world to-day than would seem possible. If one were standing in certain parts of Arabia at this moment, he would observe that the tribesmen always pray under a heglik tree. Travelling on the Guinea coast he could not touch certain sacred trees on peril of his life. In the Congo he would see a holy tree before each village house with jars of wine under it as offerings to the tree spirits. In Bengal, the people regard the sal tree as their national protector and the resort of all family gods. They hold annual festivals in sal groves. In the Dahomey region of Africa, certain sacred trees such as the Hun'-tin are provided with women caretakers who act as their servants.

Why do we decorate our houses with holly and mistletoe at Christmas time? It has become a festive custom with us, but our barbarous ancestors who originated the habit believed that when they brought holly and mistletoe into a house the spirits which inhabited them and kept them bright and

AT THE EDGE OF A CALIFORNIA REDWOOD FOREST

A YOUNG BANYAN AT KEY WEST, FLORIDA, DECORATED WITH WHITE PAINT

green all winter would come too and bestow their blessing on the inmates. Doubtless such also was the origin of the use of the fir tree for winter indoor festivities. This tree by retaining its greenness all the year was regarded as a special favourite of the tree-spirits.

Why should date and palm leaves appear in Gothic architecture? They do not grow in the cold latitudes which gave the world that noble style of building, but they were sacred to certain ancient Assyrians and Hebrews. Embodied in their records, they were taken over by Christianity and made symbols in the walls of northern churches.

The may-pole dance is a harmless diversion of children, but in its original form it was a heathen orgy to the wood spirits and was believed to insure fertility in man and beast.

To this day, a maiden of Silesia places an apple under her pillow on New Year's Eve and expects to see her future husband in a dream at midnight. Whether she does or not probably depends upon the tranquillity or perversity of her digestion, but even her most enlightened sister of America or England lapses occasionally into one of the senseless but beautifully romantic tree-superstitions which have come down to us from barbarism.

Many of the religious and social customs of the

ancients were repulsive and revolting, but in tree worship we usually find nothing but beauty and idealism. As we look upon the grace, the symmetry, the nobility and the grandeur of a stately tree, it is not hard for us to imagine times and conditions when we ourselves might worship it.

XIII

CURIOUS TREES

There at the foot of yonder nodding beech
That wrestles its old fantastic roots so high,
His listless length at noontide he would stretch
And pore upon the brook that bubbled by.

—GRAY.

ONE reason why the study of trees is so fascinating is because of the unusual and extraordinary elements they continually present. In the vast expanses of the tree kingdom are many species and individuals which, by veering from the expected and the normal, have made themselves noteworthy for all time.

Who has not heard of the big trees of California —those gigantic sequoias and redwoods which tower to unbelievable heights? They are possibly the most extraordinary trees in all the world. They are really relics of the pre-glacial ages of huge reptiles, gigantic ferns and other strange natural forms. The three-toed horse, the hairy mammoth and the sabre-toothed tiger are believed to have been

their first contemporaries. There is good evidence that the sequoias once covered a large part of North America reaching well up toward the pole. The coming of the glacial ice and the resulting change of climate wiped them out with the exception of the small groups still existing on the western slopes of the Sierra Nevada Mountains.

Among the magnificent sequoia specimens of the Mariposa and Calaveras Groves in the Yosemite National Park are direct descendants of the ancient trees which survived the polar ice. The largest are considerably over four hundred feet tall and over a hundred feet in circumference at the base. Good average mature sticks point up for two hundred and fifty to three hundred feet. It would take six lusty elms mounted one above the other to reach this height.

The many pictures of these trees with men and horses grouped about their bases in pigmy attitudes give vague ideas of their immensity, but perhaps the impression becomes more concrete when one learns that a recently felled specimen was converted into 3000 fence posts, 650,000 shingles (enough for 70 to 80 houses) and 100 cords of firewood, which no one could use because of the expense of hauling it away. After this there still

A NATURAL TEMPLE IN PIKE NATIONAL FOREST, COLORADO

THE AFRICAN CEIBA OR SILK-COTTON TREE IS OFTEN AN OBJECT OF VENERATION

remained unused the upper third of the trunk and all the branches.

The trees vary in age from two to four thousand years, though some authorities after examining the annual rings of the stumps ascribe an even greater age to some of the living giants. At any rate, we must go back to the Age of Pericles or the time of King Solomon to gain an idea of the period in time when they were young.

It is the sequoia, or, to be scientific, the *Sequoia gigantea,* or the *Sequoia Washingtoniana,* which has this extreme age and height. His redwood cousin, the *Sequoia sempervirens,* can almost equal his size. In appearance, both varieties are most impressive. Their beautifully fluted trunks rise from a needle-carpeted ground like immense cathedral columns. Far above, their cedar-like foliage unites into an airy green roof. If ever there were natural temples, it is in these groves.

The sequoias, tall as they are, must yield on mere size to the eucalypti of Australia. Travellers all agree that these tremendous growths are quite the tallest trees yet discovered. The eucalyptus is said to be very rapid growing in its habits but is not known to attain any remarkable age.

Another tree of immense proportions is the banyan or Indian fig, sometimes called the peepul-tree.

This creature attains its noteworthy size in a lateral instead of a perpendicular direction. As the main branches grow, they throw down roots or props which, fastening themselves in the ground, send out branches of their own. This continues indefinitely, until a great vegetable structure of many trunks and interlaced branches results. The trunks are massed close together near the original stem, but are wider apart, like great wooden columns, in the outer regions. The effect is that of a great grove of connected trees—a real natural temple.

On the banks of the River Nerbudda is a banyan which is said to be capable of sheltering 7,000 men. History claims it to be the same tree described by Nearchus, the admiral of Alexander the Great. High floods have at various times swept away a considerable part of this extraordinary tree, but what still remains is nearly 2,000 feet in circumference, measured round the principal stems; the overhanging branches not yet struck down cover a much larger space, and under it grow a number of custard-apple and other fruit trees. The large trunks of this single colossus amount to a greater number than the days of the year, and the smaller ones exceed 3,000, each constantly sending forth branches and hanging roots to form other trunks and become the parents of a future progeny. And so we find

that many of these ancient giants are more wonderful than the palaces and temples reared by proud kings! On the Point de Galle Road in Ceylon is a beautiful banyan which has thrown an arch over the highway. There is a young but lusty specimen growing on the grounds of the Army Post at Key West, Florida. It is said to be the only one in the United States. One can hardly blame the Hindus for attaching religious significance to these most remarkable trees.

A tree of tendencies similar to the banyan is the ceiba or silk cotton. This also lets down aerial roots which grow into the ground and become buttresses for its immense branches. A ceiba of unusual size is the one near the Government House at Nassau in the Bahamas.

On the Greek island of Cos is a giant plane tree which has become so old and ponderous that it has become necessary for public-spirited citizens to support its branches with marble columns. It occupies a prominent place in the public square and the people almost worship it.

For many years, people all over the world talked about the Dragon Tree of Teneriffe (*Dracæna Draco*). It was a member of the lily family and was considered a wonder of vegetation. Its leaves waved in the breezes seventy-five feet above the

ground. Its trunk was forty-eight feet around, and had a staircase built in a hollow portion. The Dragon Tree fell in 1867.

A most curious growth is the baob, baobab or monkey bread tree (*Adansonia Oregona*). It flourishes in various parts of the world, but is especially prolific in the Kimberley district of northwest Australia. The natives there call it the bottle or gouty tree, because of its tremendously enlarged trunk. It starts out in life slender enough but takes on a surprising girth with the years (much as if it had been addicted to the bottle). Sometimes the stem is almost spherical like a turnip. Trees only ten or twelve feet high may have trunks 70 or 80 feet in circumference. The branches extend for a distance of 50 or 60 feet and form the base of a hemisphere of verdure 150 feet in diameter and very pleasing in texture. Occasionally, the immense trunks grow in pairs. With their exposed knotty roots, they suggest to the imaginative mind some huge, double-headed octopus.

The wood composing these immense trunks is soft and spongy and filled with a mucilage-like sap. In time of drought, the fibre is fed to cattle because of the large amount of moisture it contains. When a baobab is cut down, a new tree frequently arises from the prostrate trunk.

The flowers are white, something like those of the eucalyptus. They develop into a thin-skinned fruit, covered with green hairs and about the size of a small cocoanut. It contains a flour-like powder of acrid taste which mixes well with water to form a pleasant, thirst-quenching drink. The fruit of the African species hangs on a slender two-foot cord much like an electric light bulb. In that country, small families often find comfortable living quarters within the decayed interior of a hollow baobab trunk.

Australia, whose flora is quite different from any other place in the world, is also the home of the beef tree, which yields wood the colour of a raw steak; the grass tree, which in lieu of foliage has green hair-like growths all over its trunk; and the fire and flame tree which at certain times of the year blazes with brilliant blossoms.

Many trees are famous for the queer products which they manufacture. A number of these are described in the chapter with that heading. The cow tree or palo de vaca is found in Venezuela. It inhabits rocky soils of high altitude, and is reported to be able to get along without moisture of any kind for six or seven months. When rain does come, it stores it up in the form of a thick, creamy "milk" of a balmy odour. On being drawn from

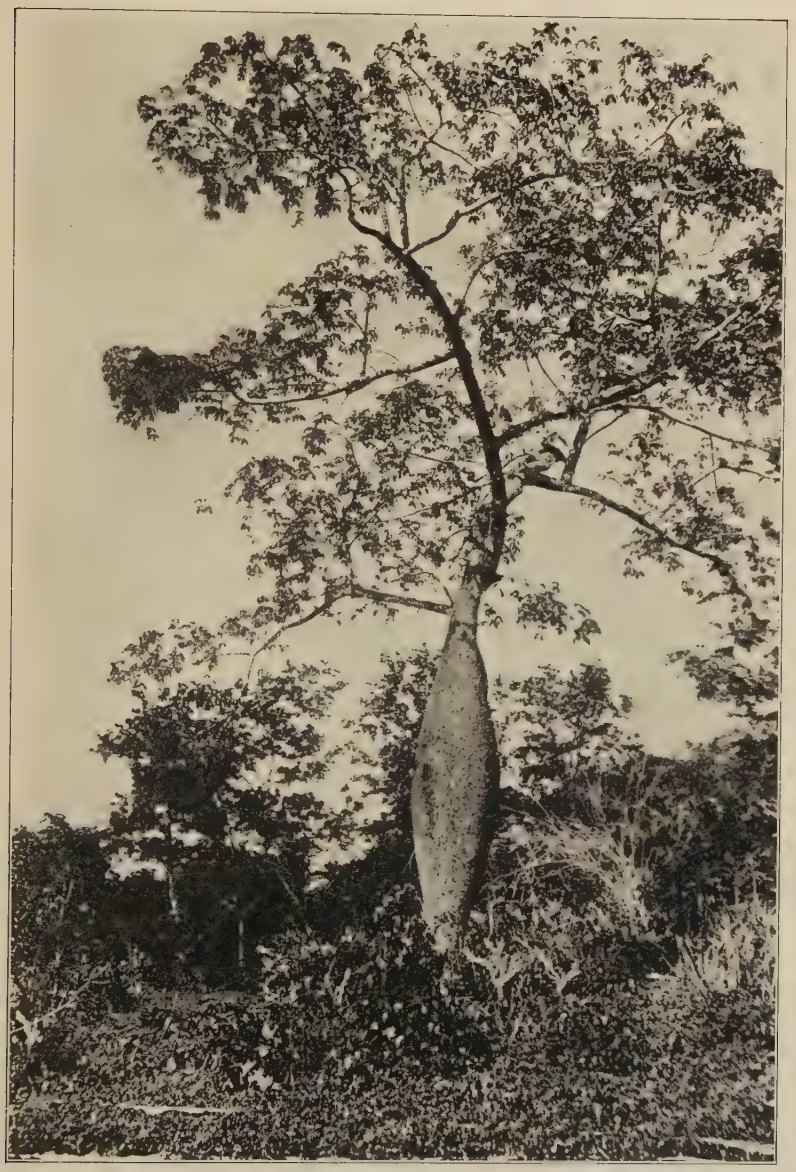
the tree and allowed to stand, this milk thickens to a substance much resembling cheese. It is doubtful whether either the milk or the cheese could compete in the world's markets with the Simon-pure cow variety.

There are a whole series of Indian, African and South American plants called butter trees. They mostly yield fixed oils which have more of the properties than the colour and consistency of our familiar dairy product. It is in the nuts that the oil is most often found.

In the South Sea Islands the natives have cheap lighting bills. All they have to do is to place a few baked kernels of the tallow or candle tree on a stick and they have a torch which yields a bright clear light. The tallow can be extracted from the seeds by boiling. It is sometimes used for food.

From the candle tree of Panama hang cylindrical wax-like fruits which look like tallow candles. Unfortunately, they cannot be burned.

In Madagascar are many dry and arid regions. A flourishing native of such sections is the traveller's tree. Many a thirst-stricken wanderer has come upon these friends of man and rejoiced at his find. No matter how hot the temperature or how long ago the last rain fell, their enormously thick leaves will always yield about a quart of clear,



A CURIOUSLY SHAPED BARRIGUDA TREE, A BRAZILIAN SILK COTTON

THE QUEER-LOOKING CHINABERRY TREE IS GROWN IN ALL TROPICAL COUNTRIES FOR ITS MAGNIFICENT SHADE

agreeable water. These leaves are incidentally very beautiful. They grow on opposite sides of the stem to form the ribs of a perfect natural fan. The tree has a decidedly economic use aside from its functions as a water reservoir. The stalks make excellent walls for houses and the leaves serve as first-class thatch.

Travellers in China often remark upon the brilliant and lustrous paint which universally adorns the river junks. The basis of this paint is the product of the Chinese wood-oil tree. The oil is pressed out of the green fruit when it is about the size of an apple. A considerable amount is exported to Europe and America.

The lacquer-tree (*Rhus vernicifera*) manufactures an acrid, poisonous juice from which lacquer is made. The industry has been carried on in Japan for 1200 years.

The life-tree hails from Jamaica. So fond of existence is this plant that its leaves will continue to grow after having been broken from the stem. It is said that fire alone is capable of destroying the tree's term on earth.

In western India is a tree that blossoms only in the dark. For some reason, possibly because, as ordinarily seen, it is of plain and desolate mien, it is called the sorrowful tree. Every evening in the

year it breaks out into bloom, but with the rising sun sheds or folds up its flowers. Often a great deal of dew condenses on the blossoms just before dawn. When they close up, this moisture falls as a miniature shower.

The strangling fig of Mexico and other tropical countries belongs to the class of plant murderers. It is an epiphyte or plant which perches on another. Its seeds float about in the air until they find lodgment on some unoffending tree-neighbour. Forthwith they sprout and push thick amorphous roots down to the ground. At this stage, the fig looks for all the world like some thick liquid flowing down the invaded tree. With roots firmly established in the ground, the intruder commences a campaign of active development and literally chokes and strangles its victim to death within the tube of its own body. Often the root connection with the ground is entirely broken and the murderer thrives entirely on the substance of its victim, pressing so tightly as to stop the flow of sap.

The banana with propriety could be called "the tree that grows while you wait." Under ordinary conditions this luxurious tropical resident develops from a tiny little "sucker" to tall spreading maturity in a single year, but it is capable of still greater efforts when necessary.

Sever a good-sized, healthy banana tree from its roots during the wet season and it will not die. On the contrary, it will send up a new shoot from the centre of the stump, and, as if striving to make up for lost time, in forty-eight hours will be waving one or more good-sized leaves in the breeze. It is claimed that during the early stages of this spurt, one can actually see the growth of the new section, much as plants are sometimes made to grow before one's eyes on the motion-picture screen.

In many parts of the world are so-called freak trees which arouse amazement because of their mere position in the world. A remarkable example of tree courage can be seen at Greensburg, Indiana. High on a Court House tower at a point 110 feet above the ground flourishes a lone maple tree. It is thirty-five years old, fifteen feet tall and four inches in diameter. Its entire substance is obtained from the air, the rain, and material in the crevices between the stones in which its roots are lodged. It formerly had three companions. The largest was removed in 1887 because it was beginning to dislodge the huge stone blocks. The other two died a little later during a period of intense heat. It is natural to assume that all four were planted in their decidedly unusual position by the wind. The surviving tree probably does not fit into the archi-

tectural scheme of the Court House very gracefully, but the authorities do well to leave it unmolested as an example of the wonderful way in which Nature's efforts sometimes work out.

A somewhat similar case is reported from the Island of Trinidad. Here the tree started on the ground but at the bottom of a tall brick chimney once connected with a now abandoned sugar mill. Up through the long, cramped tunnel the tree bravely struggled until, emerging from the top, it was able to bask in sun and air unconfined.

Near Fort Pierce, Florida, they tell of a hazard-loving rubber tree perched fifty feet above the ground in the fork of an old dead pine. It receives its substance through a single root which it sends down to the earth.

The yucca palms which live on the edge of the Mojave Desert in Southern California are queer trees. On their few straight limbs are rigid spine-tipped leaves of ashy grey. The older ones droop dejectedly. In the spring, dingy white blossoms give out a repugnant odour. Seen along the top of some mountain ridge, these weird tree productions of nature have an eerie, fantastic and unearthly look. For all their demoniacal appearance, they are of service to the men of the region. They

furnish them with small, savoury fruits and seeds which can be ground into flour.

Probably the most curious and monstrous trees in all the world are the olive trees of Majorca. Here our interest is in something more than mere size, fruit or even appearance; it is in an abnormality and grotesqueness which are positively mystical and uncanny. The olive was not native to the Island of Majorca, but was introduced there by the Romans. Some peculiarity of soil or climate has resulted in the production of a grove of trees of most remarkable forms and shapes.

The trees are very old. In most cases, the centres of the huge trunks have entirely disappeared, leaving supporting fragments of peculiar outline. The upper portions of the main trunk are usually intact, but so contorted as to be scarcely recognisable. Scraggly, crooked and entangled, these trunks assume the most demoniacal shapes imaginable and look like anything except trees.

George Sand once marvelled over them and thus described her emotions:

"When a person takes a walk in the evening under their shade, it is very necessary for him to recall the fact that these are indeed trees, since, should he credit his eyes and his imagination, he would be overcome with fright in the midst of all these fan-

tastic monsters—some curving toward him like huge dragons with gaping mouths and outspread wings, others coiled like torpid boas, and still others embracing each other with fury like gigantic wrestlers. Here is a centaur on a gallop, carrying upon its hindquarters something like a hideous ape; there is a nameless reptile devouring a panting hind; farther along, a satyr dancing with a he-goat not so ugly as himself; and often it is a single cleft, knotty, twisted and crooked tree that you would take for a group of ten distinct trees, and that represents all these various monsters and unites in a single head, which is as horrible as that of an Indian fetich, and is crowned with a single green branch like a crest."

Curious trees! Their name is legion but nothing is more wonderfully curious than the life and bodily workings of the most prosaic tree nearest to the reader at this present moment.

XIV

TREES AND CIVILISATION

IF any man doubts that trees have a most direct and profound influence on civilisation, let him look at China. Centuries ago, China was regarded as one of the most advanced and enlightened countries on earth. To-day her struggles toward real republicanism are handicapped by the dead weight of a dull, stagnant population of many millions. The year she used up her trees her decadence began.

China is a perfect example of the evils of deforestation. In the eastern provinces, the benumbing process was completed so long ago that most of the people do not know that such things as forests exist. Trees still grow in the mountain fastnesses of the western regions, but they are constantly being reduced under demands for timber. When a single board suitable for use in a coffin retails for $2.00 to $3.00 in Shensi, it pays a coolie to carry a few sticks down there.

In eastern China, one may travel for hundreds of miles through a treeless waste. The war on vegeta-

tion is so acute that every autumn the people of the villages scatter over the hillsides to collect every bit of grass, twigs and other herbage which dares to show itself above the ground. This material is used for fuel and fodder during the winter and the country is reduced to complete desolation.

The resulting train of evils is inevitable. At all ordinary times the rivers of China are dry, rock-strewn gullies. Deep wells barely yield enough water to keep the people alive. Whenever the wind blows at all hard the air becomes saturated with great clouds of pulverised dust. It enters all houses through various cracks and crevices and makes vision outdoors difficult. Small particles remain suspended in the air for days.

When rain does come, it nearly always brings disastrous floods. The water rushes down the bare hillsides into the river gullies and becomes a raging torrent. The flood spreads out into the adjoining country and strews the fields with crop-ruining stones and boulders. There is a continual washing of soil from the highlands. The Yellow and other rivers annually carry tons of rich earth out to sea.

The Chinese have saved some of the hillside land for cultivation by building elaborate systems of terraces. How much better it would have been to have spared some of the trees which formed its original

and natural protectors! To restore China's forests now would necessitate many centuries of elaborate toil.

The effect of the deforestation on the people is obvious. The resulting impoverishment and frequent famines have made them men and women without ambition and initiative. They have to spend too much time keeping alive to think much of making progress. Except for small groups or isolated ornamental specimens, the Chinese never see a tree, and so lose all the spirit of uplift and inspiration which man's forest friends always radiate.

The picture of China to-day is a picture of America in a very near and imminent to-morrow. The fate which has overtaken China, India, Palestine and parts of Spain is in store for her unless she mends her ways. This is not sensationalism but a prediction as sure as the statement that water will run down hill.

When the white men first came to North America, they found a continent completely clothed with beautiful forest verdure. There were great central prairies to be sure, but at least three-quarters of the country, comprising 850,000,000 acres, was wooded. For three centuries we have hacked away at this great sylvan store house with unprecedented

vigour. To-day the end is beginning to be visible. It is estimated that we are using each year wood much in excess of that naturally produced. Under present methods of exploitation the most optimistic figuring only places serious wood shortages some ten to fifteen years away. The price of wood and paper is steadily mounting.

Devastating spring floods have become an expected thing in the United States, especially in the Mississippi States. As long ago as 1900 or 1901 Theodore Roosevelt warned his fellow-countrymen that the forestry situation was one of the gravest internal problems confronting the country. His words are still true.

The rate at which our timber resources are being consumed is almost unbelievable. It is estimated that the railroads alone use over 150,000,000 ties a year. Wood for all purposes taken from the forests annually amounts to 22,000,000,000 cubic feet, valued at $1,375,000,000 (1916). The 48,000 sawmills of the land waste in sawdust and scraps about 36,000,000 cords each twelve months. Since 1870, the annual loss from forest fires (largely the result of careless lumbering methods) has been approximately 50,000,000 acres, valued at $50,000,000.

The general practice still largely in vogue is to

get the wood out of the forest in the cheapest way possible. The ground is left littered with twigs and small branches, a veritable fire trap for the first locomotive's spark or the first camp fire ashes. The inevitable conflagrations reduce the most luxuriant woods to desolate wastes. Even the soil of vegetable mould is often burned. In some lumbering regions, there is very little left to be consumed. In cutting for the pulp mills, everything, young and old, large and small, down to six inches is taken. When the fires get through nothing much more than the naked rock is left. There are many such sections in which it will be impossible to re-establish a natural stand of timber in less than one hundred years. When the trees do come, they are liable to be inferior specimens because of the deteriorated condition of the soil.

Such large scale tree-murder is not only appalling to the esthetic sense, but economic suicide as well. If it were a necessary evil, we might be justified in shrugging our shoulders and resigning ourselves to the inevitable. But deforestation for a country like the United States is no more necessary than a famine in foodstuffs. The whole remedy lies in an idea. People are too prone to look upon the woodlands as a definite fixed amount of natural wealth in exactly the same way as they

look at a deposit of coal, copper or zinc. It is there for use. Once it is used up, it cannot be replaced. This conception is fundamentally wrong. The forests can be made to be perpetual living resources. In their relation to man, they should be classed as crops and not as unreplaceable timber. Properly managed and taken care of, they can be made to last forever.

This is no idle theory. All the nations of Europe, particularly Germany, are operating large sections of woodland on this basis. The American government and the more enlightened private owners are using scientific methods of forestry on a large scale.

A tree requires less individual care than any other productive plant. All it asks is space and room to grow under approximately natural conditions. The city of Zurich, Switzerland, has owned a forest for one thousand years. For six hundred of these, it has furnished a definite generous yield of timber annually. It is now in better condition than ever before. As early as 1300, northern Europe adopted some of the principles of national forestry which we in the United States are just beginning to accept.

As the habit of cultivating tree crops gets more firmly fixed in modern life, it is predicted that we will look more and more to the trees for our food.

The grains are now our great staples, but if we could only transfer our allegiance to the nuts (which are extremely nourishing), a great economic saving would result. The feeble wheat must be carefully nurtured in specially prepared soil and succumbs easily before heavy rains and early frosts. Orchards yielding acorns, walnuts, chestnuts, chincapins, hickory nuts and pecans require next to no attention and need no soil ploughage at all. The very fact of the small labour outlay required will militate strongly against the general adoption of nut-cultivation. There will be more opposition to it than greeted the spinning jenny. Fruits of all kinds are, of course, already grown on a large scale, but if we could only cultivate a taste for acorn flour, the trees would come into their own. Chestnuts have long been a popular crop in Italy. The chestnut orchards there are said to net their owners as much per acre as the best wheat lands in the United States.

When it comes to the relation of the trees to rainfall, one of the most vital spots of our civilisation is touched. The water that descends upon the surface of the earth is disposed of in one of three ways: (1) It goes back into the air by direct evaporation. (2) It runs down to the sea in streams. (3) It percolates into the earth, where it is held as in a

reservoir, to be fed gradually into the brooks and so furnish a constant supply of fresh, running water.

In the temperate zone, the water disposed of by direct evaporation is negligible. Under normal conditions, a little of the rainfall runs off into the streams immediately, but the great mass of it filters down into the great earth reservoir. Now, the only way that land can be kept soft and spongy enough to absorb water is when it is protected by trees. When exposed to the sun, it invariably takes on a hard, dry crust off which the water tends to run as off a board. This then is the vital reason for the maintenance of large forest areas, particularly in mountainous regions where great rivers take their rise. Destroy the natural tree protectors of the water sheds and a distressing succession of floods and droughts always results.

Fortunately, far-sighted men in this country have seen the urgency of this phase of the forest question for some time. A somewhat lethargic public opinion has been aroused to its importance. There may be still time to prevent disastrous results.

Successive presidents for a number of decades have set aside increasingly generous tracts of the national domain. The states, led by New York's million-acre Adirondack reservation in 1885, have

A GOVERNMENT-PROTECTED STREAM HEAD IN THE SOUTHERN APPALACHIANS

THIS MAGNIFICENT ADIRONDACK LANDSCAPE IS FOREVER PROTECTED AGAINST WHOLESALE DESTRUCTION

followed suit. The vital water sheds of the country are gradually being withdrawn from private exploitation. It looks as though we have begun to solve the problem of adequate rainfall distribution, if not the almost equally important problem of timber conservation.

Up to 1916, the federal government had under its control 156,114,895 acres of forest land, in which is included one-fifth of the country's standing timber. Some of this is in the form of national parks, where all private cutting is forever barred. A large part is in the form of reservations where private tracts exist but are subject to government regulation.

The United States Forestry Service is now an important bureau of the Department of Agriculture. It maintains large bodies of forest rangers and fire wardens on the public lands and makes exhaustive studies of improved forestry methods. With the various state bureaus, it is gradually teaching private owners the proper way to handle woodlands.

Forestry has become such a live issue in the United States, that many colleges, notably Yale, have established schools devoted to the subject.

It may be interesting to briefly consider some of the principles governing the scientific care of trees.

Forestry, or sylviculture, as it is sometimes called, is simply an intelligent and far-sighted management of woodlands. It may be done for a commercial motive with the idea of producing the highest grade lumber at the least cost. It may be done as a protective measure and involve the cultivation of a body of trees as a windbreak or the regulators of important streams. It may be done for esthetic reasons to minister to man's striving for the spiritual and to satisfy his innate desire for communion with the trees. In all cases care and sympathetic treatment are the watchwords.

The simplest sort of forestry comprises some form of selective system. Only the mature and marketable trees are cut down. The others are carefully protected from injury and allowed to grow to their full size.

When the trees are all of approximately the same age, clear cutting is usually advisable. Under this method, complete sections of the forest are removed at one time. On an exposed slope the thinning effect of selective cutting makes the remaining trees liable to uprooting by the wind. By making clean cuts this danger is avoided. The cut-over area should at once be started with young trees. In some cases, neighbouring trees in the forest can be counted on to propagate their kind on the clear-

ing. At other times, a better result is obtained by artificial planting.

More complicated methods are the various shelter-wood systems. Their principle is to grow young trees under the shade and protection of their fathers and mothers. A virgin forest is often cleared of its more promising specimens in what is called the seed-cutting. After reproduction has taken place and young trees have gotten a firm start in the openings, a final cutting takes out all of the original timber.

With certain species of trees a coppice or lazy man's system may be practised. This is no less than not to provide for new trees at all, but to rely upon sprouts from old stumps to furnish new growths. These, however, rarely develop into stately and useful trees.

Under any of the régimes, forest development should be aided and protected in numerous other ways. The woods must be thinned to provide all specimens with the requisite amount of air and light. Small specimens must be liberated from the overbearing shadow of greatly advanced individuals. Trees that are hopelessly deformed or damaged by the elements should be removed.

Protection against fire is a great problem in itself. Fire not only kills great numbers of trees, but often

causes them to be replaced by great areas of scraggy bush. Large sections of the once-wooded Pocono Mountains plateau in Pennsylvania are now covered with low, monotonous-looking bushes.

A littered forest is greatly more susceptible to fire than a clean one. If all brush and loose twigs are collected and carefully burned the risk is cut in half. Locomotives running through heavily wooded districts should be made to burn oil or be provided with spark-arresters. Water courses, roads, trails and specially dug ditches are very effective in stopping surface fires. Nothing is better than an ordinary dirt road. The opening of as many roads and trails as possible is one of the first steps in good forestry. They serve the double purpose of fire lines and means of quick communication.

American business men have definitely adopted the principles of scientific management. They can be applied to the growing of tree-crops as well as anything else. On any so-called abandoned New England farm, pine seedlings with a little care can be grown to be worth $150 an acre in forty years. This may not be a very attractive proposition to a man who must have quick returns, but it is a splendid investment for a company organised to take advantage of just such opportunities.

The city man need not stand aside from the fight for better recognition of the place of the trees in modern civilisation. The cities need the trees as much as the country. In an esthetic sense, they need them more. Large urban areas are completely void of beneficent shade and leafy inspiration. Streets are often planted with trees which are out of keeping with their surroundings.

The study of city tree-planting is a considerable art. It is not given to every man to know untaught when it is best to plant the small and close-crowned horse chestnut beneath an iron grating. Only experience teaches that the Norway maple, the Oriental plane and the English elm are best in formal open spaces. It is hard to understand that the wide-spreading oaks and elms, beautiful as they are, should be restricted to the freedom of parks and boulevards.

Yet these things are gradually being learned. The Mall in Washington is a magnificent avenue of inspiring trees. Many other towns and cities can exhibit splendid examples of perfect tree culture.

THE END

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